E-business and Strategic Management: E-valuation Quality Performance based on ADAM Methods

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***Abstract*— E-business and strategic management problems in Digital Information Management (DIM) methodologies, Smart Environments (SE) and e-services can be efficiently solved by using a class of adaptive algorithmic modeling (ADAM) procedures. A class of implicit and explicit relationships and attitudes in strategic management and performance in DIM is presented by considering the proposed adaptive algorithmic approach. The adaptability and compactness of the proposed algorithmic schemes combined by the proper choice of singular perturbation parameters allow the (near) optimum solution of a wide class e-business and strategic management problems in Digital Information Management and e-services environments. This research work is based on key-field concepts of four interrelated sciences, i.e., Computer Science (adaptive algorithmic theory), Applied Mathematics (singular perturbation theory and partial differential equations), Management Science (strategic management and e-business) and Economic Science (performance). The proposed adaptive algorithmic approach has been applied to a class of case studies of characteristic e-business and strategic management problems and their corresponding dynamical algorithmic schemes have been presented. The ADAM technique has been used for constructing the basic questionnaire containing the "Phillips-Lipitakis" model, methodology and assumed hypotheses.**

Keywords - adaptive algorithms; digital information management; e-business; e-services; quality performance evaluation; strategy management; the ADAM methods.

I. INTRODUCTION

In recent years, extensive research has been directed to the dynamic fields of e-services computing, digital information management and context management for smart environments [3, 6, 11, 14, 20, 29, 32, 34, 35]. Intense investigations have been also focused in various challenging issues related to the above fields, resulting from the usage and application of other important technological and scientific branches, such as e-business, strategic management, knowledge management, algorithmic theory and computational methodologies, in order to identify novel concepts, theories, methods and techniques that enable their efficient application in the new emerging hybrid technological and scientific environments [2, 7, 10, 13, 16, 29, 31, 40, 42, 43].

In this research study, we present an alternative approach for evaluating certain e-business performance and strategy management methodologies based on a class of Adaptive Algorithmic Modeling (ADAM) procedures.

Specifically, we consider the so-called "Philips-Lipitakis" (PL) model for e-business strategy planning and performance measurement [22] and the corresponding basic algorithmic procedure (in the form of a special questionnaire) for the PL methodology and assumed hypotheses. The PL model, in conjunction with the ADAM methods, by using the fundamental principles of adaptivity (adaptive algorithms) and uncertainty (singular perturbation parameters), is presented in a parameterized dynamic algorithmic form, which for a suitable selection of the considered parameters leads to an (near) optimum solution of the e-business performance evaluation problem. In comparison to other related research methodologies, it should be noted that the main advantages of our proposed e-valuation quality performance methodology, in conjunction to ADAM methods, allow the efficient applicability for e-business strategic planning and performance measurement problems in e-business and e-service environments [22].

The basic principles of ADAM methods with their advantages and limitations have been presented in [20, 23]. A synoptic general description of the functionality and applicability of these methods is given in the next sections.

II. THE ADAPTIVE ALGORITHMIC APPROACH AND SINGULAR PERTURBATION CONCEPTS

The basic concepts of the adaptive algorithmic approach on e-business problems and strategic management methodologies have been presented in [19, 20, 21, 23]. It is known that an algorithm can be simply defined as a finite set of rules which leads to a sequence of operations for solving specific types of problems, with the following 5 important characteristic features: *Finiteness, Definiteness, Input, Output and Effectiveness,* as described in [16, 20, 39]. The algorithms can be easily presented by the so-called '*pseudo-algorithmic*' form, that is also called

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'*pseudoalgorithm*' or '*pseudocode*' in the case of preparation computer programs/codes.

The usage of the pseudoalgorithms, with the additional important features of compactness, adaptiveness and incorporation of singular parameters that allow the computation of (near) optimum solutions, can be extended for the efficient solution of e-business and Strategic Management (SM) problems and in a wide area of corresponding applications, a part of which is presented in the references and bibliography section [2, 10, 17, 19, 25, 38, 41]. It should be noted that the stated second basic feature of the algorithm, i.e., the *definiteness* as described by Knuth [16], in the case of our proposed algorithmic approach for solving e-business problems can be *'loosely'* interpreted, i.e., certain computational steps can be described in an approximate way. This is particularly useful for the qualitative nature of certain variables and procedures involved in the given e-business problems.

The concept and application of algorithms (algorithmization) can be defined as 'The Art of Designing and Practicing Algorithms', while the term '*adaptive algorithm*' denotes here an algorithm which changes its behavior based on the available resources. The adaptive algorithm functions provide a way to indicate the user's choice of adaptive algorithm and let the user specify certain properties of the algorithm. The concept of adaptive algorithm is closely related to the corresponding concept of *'adaptive'* or *'variable'* choices of the parameters (input elements) of the algorithm. Adaptive algorithms are algorithms that adapt to contention, often have adjustable steps that repeat (iterate) or require decisions (logic or comparison) until the task is completed, are simple and easy to program. The general technique of adapting simple algorithmic methods to work efficiently on difficult parts of complex computational problems can be a powerful one in the algorithm design, evaluation and practice [18, 19, 20, 21, 23].

According to a recent McKinsey Global Institute research study [26], today's business leaders need to incorporate algorithmic decision-making techniques to successfully run their organizations. This exploratory study attempts to investigate and bridge the gap between e-business strategy and algorithmic procedures.

In the last decade, research has been directed in the study of a class of initial/boundary-value problems and the behavior of the approximate solutions of the resulting linear systems by considering a small positive perturbation parameter, affecting the derivative of highest order [42, 24].

The singular perturbation (SP) parameters have been firstly used by Tikhonov [42] for solving numerically certain classes of initial/boundary value problems. Following this approach, a class of generalized fully parameterized *singularly perturbed* (sp) non-linear initial and boundary value problems can be considered and the way that the SP parameters variation affects their numerical solution can be studied [24].

In this article, adaptive algorithmic modeling (ADAM) methods are used for providing proper data input for algorithmic modeling verification of implicit/explicit relationships and attitudes in strategic management and performance in Digital Information Management (DIM) methodologies and e-services environments. Furthermore, it can be shown that suitable adaptive algorithmic procedures can be efficiently used for solving a wide class of complex computational problems, including e-business and strategic Management problems [22]. We also point out that the selective usage of both algorithmic and SP-concepts, i.e., the usage of ADAM methods in combination with the dynamical choice of SP-parameters, can lead to (near) optimized solutions. The applicability of the proposed adaptive algorithmic approach and SP-concept methodology is demonstrated by considering a characteristic case study in e-business and strategic management applications.

The main advantage of the proposed algorithmic approach for solving e-business and strategic management problems is twofold. Firstly, the adaptive algorithms can be efficiently used for solving a wide class of e-business and SM problems [19, 21, 21A, 22A]. Secondly, the dynamical choice of the SP-parameter values, which can be related to both quantitative and qualitative nature of the input parameters (data) of the given problem, can lead to (near) optimum solutions. The efficient application of such adaptive procedures requires extensive numerical experimentation [20, 22].

III. On Certain Advances in E-Business and Strategic Management

A. E-business concept

The term e-business was initially used by IBM marketing and Internet teams in 1996 referring to strategic focus of business with emphasis on several functions that occur using electronic capabilities. E-business is the conduct of business on-line including global communication media (Internet or other electronic networks). In general e-business can be defined as the transformation of key business processes through the use of Internet technologies and is concerned with the application of information and communication technologies in support of all activities of business [1, 4, 27].

E-business can be also defined as the administration of conducting business via the Internet, including the buying and selling goods and services with providing technical or customer support through the Internet, collaborating with business partners on sale promotions and doing jointly research with business partners. It should be noted that e-business refers exclusively to Internet businesses, but also refer to any business that use Internet technologies in order to improve productivity and profitability [8, 12, 37].

B. E-business adoption

The e-business adoption can be defined as the *readiness* of the organization by having appropriate attitudes, skills,

knowledge and technology to facilitate e-business operations. The e-business adoption can be achieved through the TOP (technology-organization-people) dimensions, which are closely inter-related in such a way that a change to one of these components could have (great) effect on the others [36]. A value chain model has been developed by Porter [34] with independent activities in business, where competitive strategies can be best applied and information systems are likely to have strategic impact. Porter pointed out that the important issue is how to deploy e-business to take advantage of the Internet technology (Porter [35]) and the competitive advantage requires building on proven principles of effective strategies either by operational effectiveness or strategic positioning. In his latter paper Porter characteristically mentioned: *'…the next stage of the Internet evolution will involve a shift in thinking from e-business to business, from e-strategy to strategy. Only by integrating the Internet into overall strategy will this powerful new technology become an equally force for competitive advantage'.*

C. Quality measures of e-business

The assessment of quality in e-business is a challenging subject of research studies. In a recent paper by Mohanty et al., [28] the existing quality measures of e-business are reviewed to include the emerging success dimensions of service quality, work group impact and provide comprehensive methods for organizing various measures. A comprehensive set of quality assessment measures are presented that could provide managers with the guidance necessary to develop their own assessment systems. The authors indicate that such assessment systems have the potential to provide the required feedback for competitiveness' enhancement of the e-business.

The study presents a review of quality dimensions in e-commerce, in order to provide the following:

- Better understanding about the value of quality at a conceptual level,
- Deep insight to quality management processes and practices in e-commerce,
- The basic relationships between quality and e-commerce in such a way that it will enable future research for constructing developments.

It is pointed out that quality is a multi-dimensional construct and the contributions of different quality dimensions to business performance are related to customer's satisfaction. Note that quality has properties which are measurable or non-measurable.

The study presents a review of quality dimensions in e-commerce and their possible measures. Specifically, the following class of different quality dimensions with their attributes and corresponding measures are considered [28]:

- Reliability, Time and timeliness, Transcendence, Serviceability,
- Security and System Integrity, Accessibility, Accuracy/Clarity,
- Responsiveness, Courtesy/empathy, Communication & Feedback, Retrievability,
- Structure, Reputation/Brand, Website Intractability, Customization,
- Usability/Navigability, Availability of Website, Integrity & Trust, Functionality & Features,
- Performance, Service Differentiation, Objectivity and Flexibility.

It is also stated that the process of building an integrated e-commerce quality strategy is a dynamic, relentless and iterative procedure [28].

D. Metrics and e-Business

Researchers often require metrics in order to build analytical models and conduct empirical research studies on the impact of e-business strategies on organization and firm performance. Since the importance of metrics in all fields of studies is increasingly accepted, researchers rely on accepted metrics to construct analytical models of the impact of managerial strategies on organization performance and to validate empirical field research on specific managerial tactics

In the same lines managers engaged in net-enabled business planning look for appropriate metrics to help them analyze the success of their business investments. Managers are also relying on established metrics to validate several assumptions about their business environments and to evaluate the results of the related managerial practices.

It has been reported that recent development of metrics in several scientific fields, such as finance, management information systems, marketing, human resources, accounting etc., has been mainly motivated by the traditional management saying *'You cannot manage what you do not measure'* (International Center for Information Technology [13], Kaplan et al., [14, 15], Hauser et al. [11], Straub et al., [40]).

Managers, in the framework of the new net-enabled business strategic planning approach, are using metrics in order to easily analyze the success of their online initiatives and the old traditional saying has been accompanied by a recent report related comment '*You cannot measure what you do not define'* (NetGenesis [29]. This particular comment actually is closely related with the ancient Greek mathematical and geometrical theories about measurements, metrology and definition of measure unit [22].

A thorough examination of the existing e-commerce and e-business literature reveals the fact that it relies almost exclusively on several selected case studies and conceptual frameworks. Few research studies use empirical data to characterize the Internet based initiatives and indicate their impact on organization performance (Brynjolfsson et al., [3], Zhu et al., [44]). Furthermore, there is a lack of theory to guide the empirical work (Wheeler [43]), and an increasingly number of researchers argue that the literature

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is weak in making the linkage between theory and measures apart from subjecting proposed measures for empirical validation for reliability and validity (Straub [40]).

Towards these lines and in order to make such a linkage between theory and measures, a new algorithmic treatment of e-business, e-commerce and strategy management in digital information management methodologies, based on an adaptive algorithmic approach, has been proposed by Lipitakis [19, 20, 21], Lipitakis and Phillips [23].

Recent advances in e-business applications and technologies offer many opportunities for contemporary businesses to redefine their basic strategic objectives, transform services, products, markets and improve their work processes, business communications etc. In a recent research study by Coltman et al., [7] the drivers of the e-business strategy and performance are examined by considering the perspective of strategy content and the perspective of strategy process. By integrating these two perspectives the authors explain why, when and how certain firms are successful with e-business systems, while others remain unwilling or unable to change. A class of modeling techniques is used to show that the considered variables are heavily influenced by the unobservable heterogeneity across firms.

It is noted that a single model cannot explain the relationships between critical e-business factors such as structure, environment, feasibility, managerial beliefs and performance [6, 7].

A general model of e-business performance is used and the basic questions why and how the adoption of e-business should lead to operational and competitive advantage are explained. Four basic hypotheses have been developed and their importance has been tested by using a survey of 293 organizations and field interviews. A cross-sectional survey of senior managers has been conducted and this survey was mailed to 2,000 organizations selected from a random sample of firms across main industry sectors, such as business services (including IT and telecommunications), financial services, manufacturing, primary industries, transport/ distribution, government. Experimental results and statistical analysis for the proposed class models on business performance are presented [7].

An extended literature review on recent advances in e-business and strategic management can be found in Lipitakis [22].

IV. ADAPTIVE ALGORITHMS FOR E-BUSINESS PROBLEMS AND DIGITAL INFORMATION STRATEGY MANAGEMENT METHODOLOGIES

In the following sections, we consider a class of certain characteristic case studies concerning the investigation of implicit and explicit relationships and attitudes in strategic management and performance in Digital Information Management methodologies and e-services environments [22].

Case Study 1: *a research survey of strategic management of e-business and performance*

In the framework of a research study in e-business strategy and performance [22] a pilot survey, including a dynamic adaptive algorithmic procedure, has been conducted aiming to investigate implicit and explicit relationships and attitudes in strategic management and performance. This case study is the main basis of the survey formulation that has been conducted in a related doctoral research programme [22]. In the following, we present the corresponding adaptive algorithmic procedure (in pseudo-algorithmic form) of the considered questionnaire containing certain basic information, according to our proposed model, methodology and assumed hypotheses [21, 22, 23]:

Algorithm ALQUE-1 (QOI, BUS, LOA, FOR, THO, PAR, SOP, PER, QUE)
Purpose: This algorithm constructs the corresponding Questionnaire to the proposed model, methodology and assumed hypotheses.
Input: Questionnaire's optional information (QOI), Business sector (BUS), level of online activities (LOA), Formality (FOR), Thoroughness (THO), Participation (PAR), Sophistication (SOP), Performance (PER)
Output: Finalized form of Questionnaire (QUE)
Computational Procedure
Step1: Set up Questionnaire's optional information (QOI):
Step1.1: Company/Organization Name,
Step1.2: Answering Person's Name,
Step1.3: Position in Company,
Step1.4: Postal Address,
Step1.5: Telephone/Fax number,
Step1.6: E-mail
Step2: Define the Sector the Company/Organization does business in (BUS),
Step2.1: Business sector
Step2.1.2: Banking/ Financial services
Step2.1.3: Tourism/ Hospitality
Step2.1.4: Publishing
Step2.2: Industry sector
Step2.3: Other Public or Private sector
Step3: define the level of online activities by using a five-point scale (LOA)
Step3.1: determine the Business to Business (B2B) activity
Step3.2: determine the Business to Customer (B2C) activity
Step3.3: determine the Business to Government (B2G) activity
Step4: Compute Operational measures by using a five-point scale

Step4.1: Determine **Formality** (FOR)

Step4.1.1: usage of Total Quality Management (TQM) programs

Step4.1.2: determine level of company's formality by using a five-point scale

Step4.1.2.1: explicit goals

Step4.1.2.2: written long term plan

Step4.1.2.3: assign implementation responsibility

Step4.1.2.4: commit to long range plans

Step4.2: Determine **Thoroughness** by using a five-point scale (THO)

Step4.2.1: utilize experience

Step4.2.2: employ a number of external & internal source

Step4.2.3: follow appropriate time scheduled for plan's development

Step4.2.4: utilize a umber of organization & motivational factors

Step4.3: Determine **Participation** by using a five-point scale (PAR)

Step4.3.1: Senior Manager participation in planning & implementation of strategy

Step4.3.2: personal participation in planning & implementation of strategy

Step4.3.3: evaluation of personal participation in planning & implementation of strategy

Step4.4: Determine **Sophistication** by using a five-point scale (SOP)

Step4.4.1: company as informal planner

Step4.4.2: company as operational planner

Step4.4.3: company as long-range planner

Step4.4.4: determine company's strategic planning activities by using a five-point scale

Step4.4.4.1: short range profit plan

Step4.4.4.2: final plans era accepted by the responsible persons

Step4.4.4.3: coordinator person or group

Step4.4.4.4: planning effort supported by top management

Step4.4.4.5: decision of what business the company follows is taken by top management

Step4.4.4.6: judgment of managerial performance by company's plan

Step4.4.4.7: usage of Strengths-Weakness/Limitations, Opportunities and Threats (SWOT) analysis

Step4.4.4.8: usage of benchmarking techniques

Step4.4.4.9: usage of investment appraisal techniques

Step4.4.5: determine degree of competitive method

Stage-1

Step4.4.5.1: pricing below competitors

Step4.4.5.2: new product development

Step4.4.5.3: broad product range

Step4.4.5.4: extensive customer service capabilities

Step4.4.5.5: efforts for highly experienced personnel

Step4.4.5.6: product quality procedures

Stage-2

Step4.4.5.7: concern for lower cost per unit

Step4.4.5.8: high inventory levels

Step4.4.5.9: narrow limited range of products

Step4.4.5.10: build brand identification

Step4.4.5.11: refine existing products

Stage-3

Step4.4.5.12: influence over channels of distribution

Step4.4.5.13: effort for availability of raw materials

Step4.4.5.14: expenditure on production process oriented R&D

Step4.4.5.15: serve specific geographic markets

Step4.4.5.16: promote advertising expenditures

Stage-4

Step4.4.5.17: manufacture of specialty products

Step4.4.5.18: build reputation within industry

Step4.4.5.19: innovation in manufacturing process

Step4.4.5.20: products in higher priced market segments

Step4.4.5.21: products in lower priced market segments

Step4.4.5.22: Innovation in marketing

Stage-5

Step4.4.5.23: Innovation in marketing

Step4.4.5.24: expectations in return on investment (after tax)

Step4.4.5.25: expectations in return on assets (after tax)

Step4.4.5.26: expectations in return on equity (after tax)

Step4.4.5.27: expectations in return on sales (after tax)

Step5: Compute Organization's **Performance** by using a five-point scale (PER)

Step5.1: determine **Profitability**

Step5.1.1: return on investment

Step5.1.2: return on assets

Step5.1.3: return on equity

Step5.1.4: return on sales

Step5.2: determine **Growth**

Step5.2.1: expectations in terms of market share

Step5.2.2: expectations in terms of sales

Step5.2.3: expectations in terms of cost of transactions with customers

Step5.2.4: expectations in revenue growth

Step6: Finalize the requested Questionnaire (QUE) and apply the data to your model for verification

Note that the e-business strategic planning key-variables of our proposed model, namely (Formality, Thoroughness, Participation, Sophistication), the business performance main components (Profitability and Growth) and the 5 stages for the determination of the competitive method are indicatively marked in the above pseudo-algorithm with bold characters. A single execution of the above algorithm can express the corresponding views of each participant of the research survey on the computation of the operational measures of the considered e-business and the organizational performance by determining both profitability and growth factors. Furthermore, on the

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completion of the required execution of the ADAM methods combined with our proposed model for all the research survey participants the e-valuation quality performance of e-business can be achieved.

The algorithm ALQUE-1 provides a research survey (questionnaire) for the proposed model and strategic methodology under the assumed conditions and hypotheses, Lipitakis [22].

It should be noted that, in the framework of our proposed adaptive algorithmic approach, the given pseudo-algorithms describe the corresponding successive algorithmic steps in a general descriptive form and each of the used input (output) parameter variable names, depending on the complexity of the original considered problem, could be a (complex) computational procedure or a set of such computational procedures, which in turn may contain several other related computational modules and submodules. The algorithmic scheme can be further refined including several iterative and control computational procedures according to the specifications of the original problem.

V. TOWARDS OPTIMIZED ADAPTIVE ALGORITHMIC SCHEMES FOR E-BUSINESS AND DIM METHODOLOGIES

A special class of the ADAM methods, i.e. optimized adaptive algorithmic procedures for the research survey of strategic management of e-business and performance leading to optimized questionnaire forms, can be obtained by using the singular perturbation concept with appropriate values of SP-parameters [20, 21].

Case Study 2: *an optimized research survey of strategic management of e- business and performance*

A (near) optimized adaptive algorithm can be designed by calling the corresponding dynamic algorithmic procedure OALQUE-1 in the following manner:

Algorithm OALQUE-1 (ε_{QO} QOI, ε_{BU} BUS, ε_{LO} LOA, ε_{FO} FOR, ε_{TH} THO, ε_{PA} PAR, ε_{SO} SOP, ε_{PE} PER, ε_{UF} QUE)

where ε_{QO} , ε_{BU} , ε_{LO} , ε_{FO} , ε_{TH} , ε_{PA} , ε_{SO} , ε_{PE} are singular perturbation parameters applied respectively to the input parameters and ε_{UF} the uncertainty factor parameter applied to the output of the algorithm ALQUE-1 of section 3. These SP-parameters are determined in the course of the computational procedure. The computational procedure of the algorithm OALQUE-1 can be easily constructed by following the corresponding part of the algorithm ALQUE-1

The values of the singular perturbation parameters affecting the corresponding input variables of the optimized algorithm OALQUE-1 can be determined experimentally or approximately from corresponding appropriate mathematical model. Note that the algorithm ALQUE-1 of Section 3 can be considered as a special case of the algorithm OALQUE-1 for the choice of SP-parameters

$$\varepsilon_{QO} = \varepsilon_{BU} = \varepsilon_{LO} = \varepsilon_{FO} = \varepsilon_{TH} = \varepsilon_{PA} = \varepsilon_{SO} = \varepsilon_{PE} = \varepsilon_{UF} = 1$$

The selection of the appropriate SP-parameters leading to (nearly) optimized solutions is dependent on the nature of the considered problem and often requires extensive numerical experimentation [20, 24].

Finally, it should be noted that in the framework of e-valuation quality performance by ADAM methods the dynamical choice of the SP-parameter values, which can be related to both quantitative and qualitative nature of the input parameters (data) of the given problem, can lead to (near) optimum solutions of a wide class of e-business and strategic management problems.

VI. CONCLUSIONS AND FUTURE WORK

In the framework of the application of basic sciences (computer science, applied mathematics, economic science) by combining several of their key-field topics (adaptive algorithmic theory, singular perturbation theory, performance) in certain important topics of the general management science (e-business performance and strategic planning) and in the search of new efficient methodologies and techniques of improving e-business strategy planning and performance management, we consider the usage of innovative extendable models incorporating certain independent variables and measures in combination with the ADAM methods.

The proposed adaptive algorithmic approach has been applied to a class of case studies of characteristic e-business and strategic management problems and their corresponding dynamical algorithmic schemes have been presented. The proposed algorithms with the main advantages of their compactness, adaptability [16, 20] and by incorporating the proper singular perturbation parameters that allow the efficient computation of (near) optimum solutions can be extended for solving efficiently a wide spectrum of e-business and strategy management problems and related applications in DIM and SE [22].

Future research work is focused on the dynamical choice of the singular perturbation parameter values of adaptive algorithmic schemes representing a wide area of e-business problems in Digital Information Management applications. This choice that is closely related to both quantitative and qualitative nature of the input parameters (data) and computable variables/ procedures/ modules, can lead to (near) optimum solutions of e-business problems and strategic planning management methodologies by optimized ADAM methods.

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