

# PREDICTIVE METHODS *in* NEXT-GENERATION COMPUTING

*An Approach  
Toward Sustainability*

*Edited By*

**R. Sathiyaraj, Rajesh Kumar Dhanaraj,  
K. Arun Kumar, Rutvij H. Jhaveri,  
and A. Mohamed Abbas**

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# Predictive Methods in Next-Generation Computing

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## **Next-Generation Computing and Communication Engineering**

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Scope: The rapid growth of technology and new smart city development initiatives has made computing and communication an inevitable platform for all engineering domains. The need for a sophisticated ambient environment has resulted in the exponential growth of automation, robustness and artificial intelligence. Therefore, it is very important to address computing and communication issues in such environments in order to achieve better performance.

Edge computing has become an active research field supporting low processing power, real-time response time, and more resource capacity than IoT and mobile devices. It has also been considered to effectively mitigate loads on data centers, to assist artificial intelligence (AI) services, and to increase 5G services. Edge computing applications along with the IoT field are essential technical directions in order to open the door to new opportunities enabling smart homes, smart hospitals, smart cities, smart vehicles, smart wearables, smart supply chain, e-health, automation, and a variety of other smart environments.

However, any developments are made more challenging because the involvement of multi-domain technology creates new problems for researchers. Therefore, in order to help meet the challenge, this book series concentrates on next generation computing and communication methodologies involving smart and ambient environment design. It is an effective publishing platform for monographs, handbooks, and edited volumes on Industry 4.0, agriculture, smart city development, new computing and communication paradigms. Although the series mainly focuses on design, it also addresses analytics and investigation of industry-related real-time problems.

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*Publishers at Scrivener*

Martin Scrivener (martin@scrivenerpublishing.com)  
Phillip Carmical (pcarmical@scrivenerpublishing.com)

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## Preface

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The ever-evolving landscape of computing has witnessed a paradigm shift toward the adoption of predictive methods, intelligent algorithms, and sustainable technologies. As we step further into the era of next-generation computing, the confluence of Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT), Blockchain, and sustainable system design is transforming how societies function and innovate. The edited volume titled *Predictive Methods in Next-Generation Computing* is a timely and comprehensive compilation of research that brings together diverse perspectives on the application of intelligent computational techniques for shaping a smarter and more sustainable future.

This book aims to explore how predictive analytics, driven by AI and allied technologies, can address real-world challenges across various domains such as healthcare, transportation, energy systems, smart cities, and secure digital ecosystems. Each chapter contributes a unique insight into how predictive methodologies are being used to build efficient, intelligent, and future-ready applications.

Beginning with an overview of intelligent computational techniques and their relevance in smart applications, the book transitions into sustainable design strategies and global development paradigms powered by predictive models. The role of intelligent systems in managing urban transport, traffic, and infrastructure is examined through dedicated chapters, highlighting the importance of data-driven planning for urban sustainability. Further, the application of IoT in secure and smart development, especially in the context of smart cities and traffic systems, is discussed with practical frameworks and models.

Healthcare and biomedical informatics are addressed through predictive diagnostics, exemplified by the use of Autoencoders and Principal Components in heart disease classification. The integration of Blockchain in managing medical data and decentralized financial systems illustrates the emergence of secure and transparent computing ecosystems.

Moreover, this volume also delves into the energy domain, focusing on renewable energy integration, data center optimization, and analytics for resource sustainability — critical aspects for the green transformation of digital infrastructure. This also addresses the security and privacy issues with the importance of safeguarding data in predictive environments, a growing concern in the age of ubiquitous computing.

This book is intended for researchers, academicians, industry professionals, and students who are eager to understand the cutting-edge advancements and applications of predictive methods in next-generation computing. It serves both as a reference for ongoing research and as a source of inspiration for developing innovative solutions to contemporary challenges. Additionally, the book provides the consideration and impact of technologies on lives of all stakeholders including industrialists and academicians, customers, government and policy makers. May this book serve as a catalyst for thought, innovation, and forward-looking collaboration in the next era of computational discovery.

# Introduction to Intelligent Computational Technologies

C. Geetha<sup>1</sup>, Sajithra S.<sup>1</sup>, S. Srijayanthi<sup>1</sup>, B. Reena<sup>2\*</sup>, I. Subha<sup>3</sup>  
and Sreelakshmi N.<sup>4</sup>

<sup>1</sup>*R.M.K. Engineering College, Kavaraipettai, India*

<sup>2</sup>*Department of Computer Science and Engineering, Hindustan College  
of Engineering and Technology, Coimbatore, Tamil Nadu, India*

<sup>3</sup>*Zoho Labs, Chennai, India*

<sup>4</sup>*LBS Institute Technology for Women, Poojappura, Thiruvananthapuram, India*

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## ***Abstract***

Indeed, the convergence of smart technologies and sustainability imperatives is one of vital spectrum and focus in application development within the contemporary technological context. This chapter investigates the overlap in these domains by putting forward a framework for designing smart and sustainable applications *via* computational techniques. Building on cutting-edge Artificial Intelligence, Machine Learning, and Data Analytics technologies, it tackles challenging problems as efficiently as possible by maximizing resource utilization without compromising the environmental impact. The paper highlights some key concerns associated with the design, such as data acquisition, modeling, optimization, and deployment policy. Moreover, it discusses case studies and applications in different domains to clarify the effectiveness of intelligent computational techniques and their potential for enabling smart, sustainable development. By doing so, developers and stakeholders can work towards building novel pathways that lead to a more efficient, resilient, and environmentally conscious future. This chapter is all about gathering the right sets of elements/attributes or factors to utilize for different E-Governance services. As per this research, weak adoption factors of E-Governance have been identified and ranked using the fuzzy conjoint technique. These factors are ranked based on satisfaction levels, from highest to lowest: very satisfied, satisfied, neither/nor (ambiguous), dissatisfied, and very dissatisfied.

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\*Corresponding author: reena.cse@hicet.ac.in

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The ranking of the above factors with satisfaction levels also defines whether the government needs to focus on or not to increase adoption.

**Keywords:** Smart technologies, sustainability, application development, intelligent computational techniques, artificial intelligence, machine learning

### 1.1 Introduction

Implementing e-services, or electronic services, will have a deeply rooted impact on every citizen of the nation. If the citizens are unwilling to consume these services, it virtually defeats the purpose of provisioning and consuming e-services as they are the primary consumers. This pressure therefore blasts the call to sieve out what factors can ascertain the suitability of such services. So, the suitable factors have already been identified by the researchers. These factors are addressed as infrastructure, cost, trust, time, accessibility literacy, language, willingness, age, gender, and people awareness [1]. The success of e-services depends on how satisfied people are with their usage. There aren't many private players in the community to meet this expectation, so we need support from the government as well. Internet connectivity, including its speed and bandwidth, is a crucial factor when implementing e-services across the country. Another thing to consider is that there are new technologies out. In the case of a multilingual country, these e-services should also be multilingual. Given the variations in demand preferences for end-users across the country, it is essential to understand what specific factors play a critical role in ensuring that consumers adopt e-services. Hence, this chapter will rank acceptance factors through fuzzy joint model statistics to address the sluggish access to e-governance services. The Fuzzy Conjoint Model was proposed by Turksen and Wilson [2] in 1994. This order of factors was also validated with other ranking approaches such as those proposed by Biswas [3] and Wang [4].

### 1.2 Literature Survey

Most theories are based on the Davis Technology Acceptance Model (1989) [5], the Unified Theory of Acceptance and Use of Technology, the Theory of Reasoned Action (TRA) [6], the Diffusion of Innovation, etc. Tashfeen Miral Screwvala extended the work of Carter and Belanger (2005) [7] by identifying the 'purpose of use' factor. When deploying technology-based electronic services, the security of existing information is a highly important factor. E-services [8] introduced by the government offer numerous

benefits, including increased reusability of information and citizens' satisfaction by sharing it with general public. The author tested an e-governance service introduced by the city council of New Delhi, India [9]. The central idea is that, based on literature research, it can be assumed that the adoption of these services depends on how citizens perceive government electronic services. Table 1.1 lists some of the theories discussed by

**Table 1.1** Some empirical theories about adoption models.

Model/theory	Factors/items	Definitions	Authors
A Unified Model of E-Governance Adoption (UMEGA)	Perceived service quality and recommendation	Recognizing the quality and trust of service to the government, as well as the intent to use and recommend e-government services.	Mensah <i>et al.</i> , 2020 [11]
TAM2 (Extended Technology Acceptance Model)	Thought/Image	An image of a person after using an innovative service.	Venkatesh, 2000 [15]
	Voluntariness	Personal evaluation of the voluntary use of innovative services.	Moore and Benbasat, 1991 [16]
	Job relevance	Identify the system that applies to his or her work.	
	Quality of output	Comparison with the previous version.	

(Continued)

**Table 1.1** Some empirical theories about adoption models. (*Continued*)

Model/theory	Factors/items	Definitions	Authors
DOI (Diffusion of Innovation)	Benefits	How is the E-Governance service advantageous over its predecessor?	Rogers and Shoemaker, 1971 [17]
	Complexity	The system is relatively difficult to use and understand.	
	Observability	Determine the output of innovation.	

**Table 1.2** Factors/attributes affecting the adoption of E-Governance services.

Factors	Description	Authors
Perceived service quality and intention to use	Service quality, intention to use, and recommendations to others.	Mensah <i>et al.</i> , 2020 [11]
Transaction security	Transaction security when using e-government applications.	Rehman M. <i>et al.</i> , 2012 [19]
Transparency/fairness	Determine the transparency of electronic services.	Bertot <i>et al.</i> , 2010 [20]
Corruption avoidance	How much corruption will be reduced after the introduction of e-government services?	Bertot <i>et al.</i> , 2010 [20]
Perceived risk	Risks associated with the use of e-government applications.	Be'langer, Carter, 2008 [22]

*(Continued)*

**Table 1.2** Factors/attributes affecting the adoption of E-Governance services. (Continued)

Factors	Description	Authors
Trust in the government	Evaluate the level of government confidence in using e-services introduced by the government.	Saxena, 2005 [23]
Trust in the internet	Describe public confidence in the use of the Internet and applications.	Leitner, 2003 [25]
Customer support	Determine the level of customer support while using e-government services in case of stuck.	De Ruyteer <i>et al.</i> 2024 [26]

researchers [10] that the study or research found. Table 1.2 presents the key attributes affecting e-governance adoption.

Researchers have also examined the assessment of government websites, applications, and mobile apps. Jain *et al.* (2004) [27] proposed an evolutionary fuzzy system for evaluating supplier performance using the linguistic nature of supplier and manufacturer attributes.

Besides the various factors discussed above, some matters also need consideration, including but not limited to interoperability with other systems, resource management, and policy standardization [28]. In this context, the purpose of this chapter is to measure e-government service evaluation factors. The fuzzy conjoint model is also utilized in ranking and selecting of the suitable factors from them [2].

Conduct collaborative statistical analysis on survey data to understand the overall picture of each product and its attributes, characteristics, advantages, etc., based on columns in Likert scales like 'satisfied' and 'very satisfied'. With the survey data responses handy, you—or anyone else, for that matter—could evaluate our product as a service. Every individual has unique requirements, and according to their preferences, they tend to respond to a variety of products and services. There's no accounting for taste. Fuzzy set theory can be used for ambiguous, uncertain, and undefined tastes. As far as civic satisfaction goes, we're pretty much talking about some form of Likert-scale linguistics to begin with: HS - Highly Satisfied, S - Satisfied, N - Neutral, DS - Dissatisfied, HDS - Highly Dissatisfied. Several literature reviews identify factors such as trust in the Internet and

avoidance of corruption. However, the lack of interoperability, inability to process resources within its system, and policy standardization are some of the challenges.

Based on the above, this chapter will deal with evaluating factors that are implementable to enable the launch of e-government services. The government has launched e-governance services across various sectors and aims to analyze whether they are reaching all citizens effectively. Choose one of the following needs, describe the consequences if access rates do not meet expectations, and classify them accordingly.

In this way, we are thus able to present the fuzzy conjoint model in a chapter as an effective method of statistically analyzing survey response data and ranking factors from highest significance to lowest influential factor.

### 1.3 Methodology

The present subchapter finally introduces how the methodology is applied to finding key influencers on factors for eGovCA-launched services. We can represent the architecture to assess the factors of influence, as shown in Figure 1.1 below. Based on this architecture, which appears in a pictorial form in Figure 1.2, we use prior literature mainly to discern all the different components that affect e-services adoption. Around those parameters, a prepared questionnaire is available. The questionnaire was distributed to various people in Saudi Arabia to assess their satisfaction with e-services.

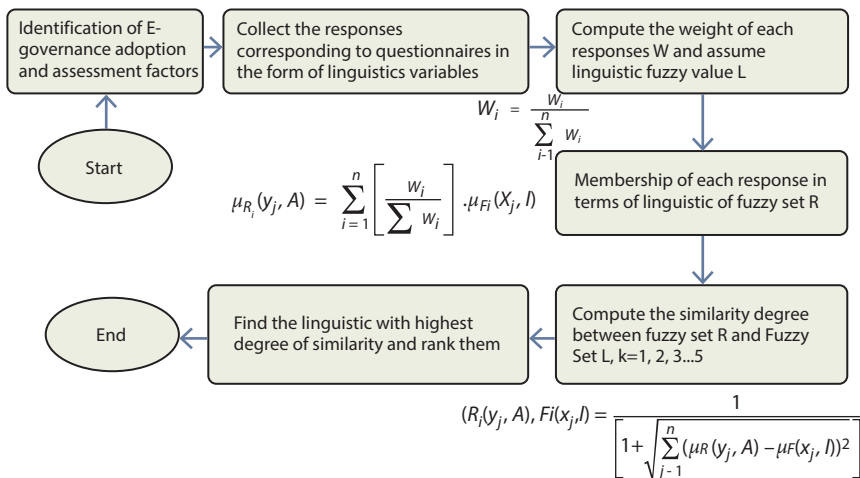
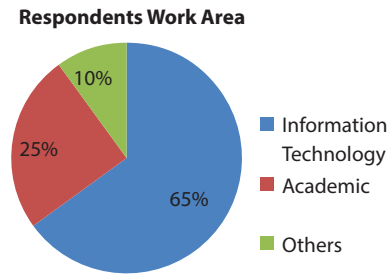


Figure 1.1 Architecture of assessing the adoption factors.



**Figure 1.2** Respondents' work area.

These responses are then summed for a Likert scale by the fuzzy conjoint model. The details of all but one of these operations are covered in this section of the chapter.

## 1.4 Simulation Metrics

In this subchapter, the simulation metrics setup is provided in Table 1.1. The goal column represents the purpose of the research. The object/entity column represents the objects based on which decisions need to be made. The questions column represents the research questions, and the output parameters represent the variable based on which the goal is achieved.

### 1.4.1 Identification of E-Governance Adoption and Assessment Factors

Table 1.3 shows the various acceptance and evaluation factors described in influential theories on the deployment of E-Governance services.

According to literature searches, researchers' focus is primarily on factors such as trust in the internet. However, it is seen that some elements are missing, such as interoperability with other systems, resource handling, capacity building, intelligence, and policy standardization.

### 1.4.2 Sample Data Collection Using Questionnaire

To understand the importance of these factors, we run a survey using a questionnaire that is similar to what has been identified above. The HELP LINK is <https://imgur.com/aH5SF8R>. Referring to the same uploaded image in Figure 1.3 of the sample questionnaire (since my surveys are

**Table 1.3** Simulation metrics.

Goal	Object/entity	Questions	Output parameters
Identification of E-Governance adoption attributes and ranking of these factors.	Questionnaire of adoption factors data and survey data.	What are E-Governance adoption factors and their ranking concerning satisfaction levels?	Using the fuzzy conjoint model, factors are ranked from highest to lowest concerning satisfaction levels.
101 responses are collected after the survey.	Demographic distinguishing	Survey data collected based on objects provided.	Demographic distinguishing/1, overall satisfaction/2, intelligence/3, trust in government/4, compatibility/5, instructiveness/6, facilitation at rank/7, and intention/8.
The methodology is verified with two other approaches.	Demographic distinguishing, compatibility	Survey data collected based on objects provided.	Ranks are determined for Wang and Biswas's approaches.
A Spearman's rank correlation and hypothesis is assumed to validate the methodology.	Ranks of all approaches	How can the methodology be validated?	The null hypothesis is rejected and the alternative hypothesis is accepted concerning the methodology.

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