

# Can Thomas Kuhn's Philosophy of Scientific Progress Explain Revolution in Cashless Payment Systems

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**Abstract** - This research seeks to evaluate Kuhn's idea of historical development of science in terms of paradigm guiding scientific knowledge and how it helps in explaining the revolution in cashless payment systems around the globe. Kuhn demonstrates science as discontinuous process with a set of alternating normal and revolutionary phases in which communities of authorities in a particular field are pushed into uncertainty. Therefore, the progress of science is both cumulative in periods of normal science and non cumulative during revolution contrary to older scientific and philosophical perspectives. Thomas Kuhn philosophy of paradigm shifts clearly illustrates the dramatic revolution and progress in payment system from barter-paper/notes to the present cash-less payment system. This research submits that the world will continue to see progress toward a cashless/paperless society, in both the advanced and developing nations. However, the total acceptance and switch to cash-less payment system would on the other hand, be the function of the country's precise, cultural, political and socio economic metrics and characteristics. As Kuhn noted, there will always be unresolved crisis left by a paradigm. These unaddressed problems in our contemporary world could be seen in terms of proliferation of cyber crime, sovereignty of Central Banks in monetary control, and how to integrate the developing regions in this transformation. Keeping pace with current revolution would never be an option to economies desirous of efficient and sound development.

**Keywords** – Kuhn, Normal, Paradigm, Revolution, Shift Cash-less Payment

## SECTION I: INTRODUCTION

The publication of the Structure of Scientific Revolution (SSR) by Thomas Samuel Kuhn in 1962 remains one of the most controversial and famous books in the history of scientific research and philosophy.<sup>1</sup> He started with a dominant statement that scientific community cannot practice its trade without some set of established beliefs (Kuhn, 1962). These beliefs construct, shape and fashion the basis of the educational training that ushers and permits or certify young scientists for professional exercise and application. The core idea of structure is that scientific research is based on underlying theoretical composition that

1. *This great scientist cum philosopher was born in Cincinnati Ohio-United States and obtained his PhD in Physic in 1949 at Harvard University.*

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provides a framework for research in a field for a sustained period of time. Kuhn's name for these structures is paradigm. Indeed it was Kuhn's use of the word that inserted "paradigm" into the popular lexicon (Sankey, 2010).

As an introduction, science is essentially derived from the Latin word "Scientia" which connotes "knowledge". It is an organized initiative and creativity that builds and systemizes knowledge in the form of testable explanations and predictions about the universe. The philosophy of science on the other hand is concerned with all the assumptions, foundations of truth and knowledge, methods, implications of science, and with the use and merit of science in life.

Kuhn (1962) questions the traditional conception of scientific progress as a gradual, cumulative acquisition of knowledge based on rationally chosen experimental frameworks. Instead, he argues that the paradigm determines the kinds of experiments scientists perform, the types of questions they ask, and the problems they consider important. Paradigm is like a workshop with all tools, problems, solutions and methods available to the engi-

neer for his operation. The engineer is incapacitated in the absence of the workshop. This is the same for a scientist. The scientist must have a platform/paradigm to perform all his experiment and researches. Therefore, before any scientific work and progress, paradigm must be the underlying prerequisite. The conscientious and thorough training helps ensure that the received beliefs put forth a deep hold on the minds of scientist practicing under the paradigm. Strict adherence to the paradigm often suppresses fundamental novelties because they are necessarily subversive of its basic commitments. He contained that it is only mature science that has a paradigm governing its operations<sup>2</sup>.

A shift in the paradigm after a period a period of extra ordinary science alters the fundamental concepts underlying research and inspires new standards of evidence, new research techniques, and new pathways of theory and experiment that are radically incommensurable with the old ones. The understanding of how paradigm undergoes transformation is important in the comprehension of the development of all knowledge and fast growing modern payment architecture.

## Research Objective and Questions

The broad objective of this research paper is to examine Kuhn's philosophy with a critical focus on: "*The Structure of Scientific Revolution*" and its application to the understanding of revolution in payment system. In order to realize the above objective, the research shall assiduously strive to answer the below relevant questions:

### Research Questions:

- i. What is the nature of scientific progress?
- ii. How does paradigm guide scientific research?
- iii. Can paradigm shift explain the revolution in cashless payment systems-the world over?

Document analysis is the methodology employed; significantly relying on the primacy of literature review. The rest of the structure of study is as follows: section two covers review of Kuhn's works and other related articles.

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2. Paradigm therefore, stands for set of general theoretical assumptions and laws and techniques for the application by the members of a particular scientific community.

Section three focuses on Kuhn's Cycle. Section four is a typical demonstration of Kuhn's paradigm shift cash-based on a cashless payment system. Section five covers the concluding component.

## SECTION II: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The search for an acceptable method, aim and nature of science dates back to Francis Bacon in the seventeen century. He proposed that the Aim of science is the improvement of man's welfare on planet earth and for him that aim is to be attained by the gathering and collection of facts through organized observation and deriving theories from them<sup>3</sup>. Since then, there has been great proliferation of theories and methodologies of science with the objective of understanding and putting science on formidable foundation.

The historical account and explanation of the evolution and progress of science becomes very necessary in order to appreciate its development in terms of theory, methodology and application. Note that, before the appearance of Kuhn, science was perceived and dominated by philosophical ideas about how it ought to developed(i.e. the scientific method), together with a gallant and daring narrative of scientific progress as the accumulation of fresh truths to the collection of old truths, or the increasing approximation of theories to the truth. In fact, science was seen as a long match towards truth.

Contrary to the above, Kuhn saw science as discontinuous process with a set of alternating normal and revolutionary phases in which communities of authorities in a particular fields are pushed and uncertainty. Based on this perspective, he classifies. Newtonian mechanics transition to quantum physics as revolutionary and corresponds to great conceptual breakthrough and lay the basis (Chalmers, 1987). In order, to adequately understanding the philosophy of Kuhn it would be necessary to explain and comprehend his conceptual underpinnings:

### Paradigm

Paradigm is a household name in the philosophy of Kuhn and has become a com-

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3. See Sankey 2010 and Chalmers, 1987 "What is this thing called Science?"

mon concept applicable to virtually all body of knowledge. Paradigm as a word essentially comes from Greek signifying pattern or example. According to Stemwedel (2010) paradigm can be viewed in narrow and broader perspective. In a narrow sense, paradigm refers to a particular achievement. The broader dimension views paradigm as a package of ideals and method which make up a world view and a way of doing science. Alternatively, a paradigm can be seen as the entire constellation of beliefs, values and techniques shared by member of a scientific community. They act as maps that chart the direction of how problem may be solved.

In Kuhn's philosophy, the importance and relevance of paradigm cannot be or emphasized. This is primary because they provide the necessary framework or what he called shared set of assumptions for normal science. In his latter publications, he used the term to mean a set of standard and legitimate procedures. Lastly, it is seen as shared example in the form of concrete problem solution distinctive of the approach of the relevant scientific community.

He believed that it is the assimilation of these standard and examples rather than the conscious acquisition of formal rules that a mature science functions and progresses. His concept of paradigm is analogous to Lakatos', Foucault's and Laudan's Research Programme, Discourse and Research Tradition respectively. He strongly argued for the protection of paradigm (Bird, 2013; Chambers, 1987, and Luadan, 1989).

## Normal Science

Kuhn's (2003) defines normal science as research firmly based upon one or more scientific achievements that some particular scientific community acknowledges for a time supplying the foundation of its further practice. Scientists are basically preoccupied in normal science (mature science). Normal science essentially does not aimed at novelties. Chalmers (1987) contends that "normal scientists must be uncritical of the paradigm in which they work. He claimed that it is only by doing so that they are able to concentrate their efforts and energies on detailed articulation of the paradigm and to perform esoteric work necessary to probe nature in depth.

Therefore, the role of normal science is puzzle-solving provided by the prevailing paradigm. As contains in Pajares (2012), nor-

mal science consists of the actualization of the promises of the existing paradigm. Similarly, Kuhn (1970) contains that a striking feature of doing research is that the aim is to discover what is known in advance. Scientists consistently aim to match theory with nature. However, outcomes are not always equal to expectations. When the outcome of a research does not fall into the expected range of result it is generally considered a failure not of the theory/paradigm but that of the method the individual scientist employed. In sum, scientific research to Kuhn is a persistent and dedicated quest to compel and coerce nature into the conceptual boxes supplied by professional teaching. This gives rise to anomalies and crisis situation. All crises begin with the hazing and shadowing of a paradigm consequent loosening of the rules for normal research.

This consequently results to revolution as crisis deepens scientists devote themselves to some to some concrete proposal formulation for the reconstruction of science in a new institutional framework. The emergence of competing camps manifests, some in defense of the older paradigm, some advocating for an alternative. Here the evaluative mechanism under normal science cannot work. Thorough debates over fundamentals. Techniques of winning members to a paradigm are persuasive in nature consequently as Kuhn notes it the paradigm that emerges from scientific revolution is not only incompatible but often actually incommensurable with the older one.

A paradigm shift becomes inevitable. It is in contrast to his idea of normal science. Kuhn suggests that after a particular theory has won out over all contenders to achieve the status and position within the problem area concerned, the practitioners of what is now a mature science behaves, for all practical purpose as if their disciplinary milieu were what corresponded with reality.

## Payment systems

In an ordinary parlance, payment system refers to any arrangement used to settle financial transactions through the movement and transfer of monetary value. This is facilitated by various participants which include: the financial institutions, instruments, people, rules, procedures, standards, and technologies that make such an exchange possible and efficient. A common type of payment system is the operational network that links bank accounts and provides for monetary exchange

using bank deposits.

Debates in favour of cash-related transactions abound in the literature. As shown by research carried out in the United Kingdom on “*The future of cash in UK*” proposes that cash differs from other payment instruments in the following regards; it circulates, it is always valuable, it offers complete and final settlement of a transaction, it allows for secrecy, once issued, the circulation of cash is uncontrolled, it is considered as public product by its users (Yaqub et al, 2013).

However, According to Cobb (2005) efficient safe and convenient electronic payments carry with them a significant range of macro-economic benefits. He demonstrates the impact of introducing electronic payments akin to using the gears on a bicycle. Put in an proficient electronic payments structure to an economy, and you jerk it into a advanced gear. Add better-controlled consumer and business credit, and you notch up economic velocity even further. This explains significantly the revolutionary progress in cash-less payment arrangements globally.

Payment systems may be material or electronic having diverse procedures and etiquettes. Homogeneity and consistency has permitted significant number of these systems and networks to mature and revolutionised to international scale. Case in point of payment systems that have become globally accessible are credit card and automated teller machine networks. The e-commerce has undoubtedly taken over in most advanced economies. This undeniably, is a paradigm shift.

The availability and use of cash-substitutes is essentially what makes payment systems viable. Long-established payment systems are the commodity based payment (barter), paper currency, negotiable instruments such as drafts (e.g., cheques) and documentary credits such as letters of credit. The appearance of computers and electronic communications in the world fabric, a large number of alternative electronic payment systems have emerged. These include debit cards, credit cards, electronic funds transfers, direct credits, direct debits, internet banking and e-commerce payment systems etc.

Advancement and revolution in cashless payment systems has largely been motivated by the perceived benefits to individuals, firms and the entire world system. It should be realized that the non cash based payment system has numerous participants. Of much relevance are the providers on one side especially the card providing firms like the MasterCard,

Visa etc who provide their payment network for the system to function. The second set of providers is the financial institutions that operate as acquirers for merchants and issuers for cardholders and reaches the card payment services to the ultimate users. The benefits these participants get from the system are: convenience, ease of credit availability, increased purchasing power and a lot more. The regulator of the system is usually the central of every country. This is similar in cash based system. Yaqub et al (2013) noted that in a cashless society, the unit of account (e.g. Dollar, Euro, and Naira.) remains a national issue provided by the state.

Cashless economy is one in which there are assumed to be no transactions frictions that can be reduced through the use of money balances, and that accordingly provide a reason for holding such balances even when they earn rate of return. In a cashless economy, how much cash in your wallet is practically irrelevant. There is a correlation between increase in point of sales volumes and rise in demand deposits. Automated electronic payments act as a gateway into the banking sector and as a powerful engine for growth (Al Shaik, 2005 and Hord 2005). The followings among others enhance the functioning of cash-less economy<sup>4</sup>; e-finance, e-banking, e-money, e-brokerage, e-exchanges etc. In a modern economy, the use of noncash payment methods such as cards (credit and debit) dominates the use of cash in payments and seems that payment systems have matured beyond handling physical cash.

### **SECTION III 3.0: TOWARDS UNDERSTANDING MAIN ARGUMENT OF KUHN’S PARADIGM**

#### **Kuhn’s Cycle**

Kuhn’s main argument can better be understood in terms of life cycle of scientific progress (Walker, 2013). In 1962, Kuhn submits that science passes through pre-science - normal science crisis – revolution to paradigm shift. To him a paradigm is hatched when a

*4. Cash-less economy does not necessarily refer to an outright absence of cash transactions in the economic setting but one in which the amount of cash-based transactions are kept to the barest minimum. It is an economic system in which transactions are not done predominantly in exchange for actual cash as in olden paradigms of payments.*

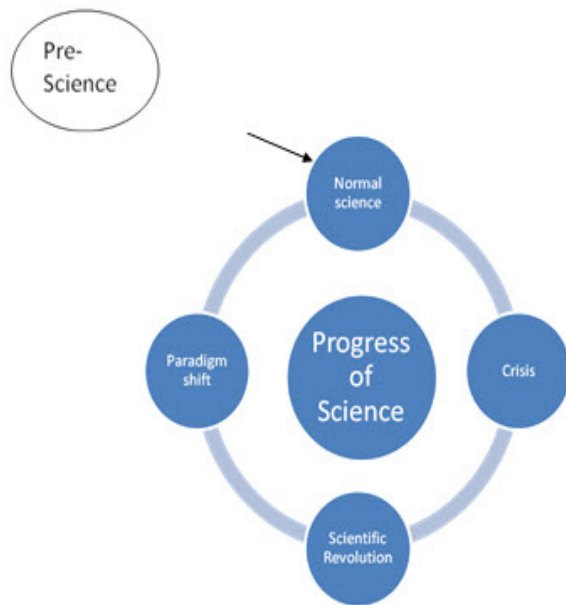
concrete scientific achievement addresses conflicts over foundations, assumption and method in a scientific field of inquiry.

## Pre-Science

This is also called the pre-paradigmatic stage. In the pre-step; there is not yet a model of understanding mature enough to resolve issues and question in a scientific field. Kuhn classifies old sciences that do not have concrete paradigm as not real, hence immature. This is so because there is always no consensus on fundamentals and highly unstructured. At this stage, scientific research may be promising and attracting new members. When science later becomes mature, a single paradigm prevails. Thus, it matures into a higher stage called normal science. See the below chart:

**Figure 1: Kuhn's Cycle**

**Source: Authors' smart art**



## First Stage: Normal Science

The role of science at this level is essentially puzzle-solving activity. Scientists' role is to defend and protect the fundamentals of the paradigm. The relevant activities here include: uncritical thinking, matching theory and nature, consensus of the scientific community, suppressing of novelties etc. As a result, the progress of science becomes basically progressive in a cumulative or linear dimension. The theory believes that the progress may also reveal anomalies. Consequently, the aggregation of these anomalies will plunge the paradigm into a drift as they persistently

and consistently resist solution. Recent studies have included model drift stage as one of the stage in the progress of science to explain how anomalies drive the progress of science in scientific research to crisis situation (Walker, 2013).

## Second Stage: Crisis

This is the second stage in the Kuhn's cycle. Here, the field's model of understanding has drifted so far that the paradigm is thrown into crisis period. The platform for solving central puzzles/problems has been shattered by discovery of excessive stubborn anomalies in which paradigm cannot provide answers to (Kuhn, 2003 and Walker, 2013). However, the existence and acknowledgement of crisis by the scientific community does not mean the death end of the paradigm as in Popper's falsificationism. Attempts would still be made differently: some to resuscitate the ailing paradigm until new one is on board and some in finding a new theory. The transition from crisis ridden-normal science to a newer paradigm is scientific revolution and can be seen as the transition from normal science into extra ordinary science.

## Third Stage: Scientific Revolution

A scientific revolution is a non-linear developmental incident or episode in which an older paradigm is replaced in whole or in part by an incompatible new one. A scientific revolution results to discontinuous development of science. Scientists engage in persuasive arguments and debate towards winning and gaining members into their desired paradigm just as in the case of political revolution. At this stage, there are different reasons scientists attach to or consider before supporting and giving their allegiances to an alternate rival. Kuhn believes that normal science or adherence to rules cannot offer explanation to this unusual and unprecedented behaviour. This is because of differences in opinions and values, and most importantly, social influence of the scientific community.<sup>5</sup>

## Fourth Stage: Paradigm Shift

At this stage, a new single paradigm establishes its complete dominance in scientific

<sup>5</sup>. This is what he termed "Incommensurability of paradigms"

development. The new paradigm becomes the successor of the worn-out theory. In the Paradigm Change step the new-fangled paradigm is inculcated in beginners in the field, as well as to those already in it, dogmatically. When the new paradigm becomes the generally accepted guide to one's work, the step is complete. The field is back to new normal science step and the Kuhn Cycle is transformed with new innovations and overall scientific progress.

Here, he submits that there will still emerge new crisis in the new normal science and again to crisis situation. This is because no paradigm ever resolves all puzzles. This is how scientific progress is achieved in the Kuhnian scientific and philosophical paradigm and explains the entire historical development of science and all form of knowledge.

Differences in scientific concepts, language and hosts of reason make commensurability of paradigm impossible. Kuhn thinks that a description of science must, in the ultimate examination, be psychological or sociological. Therefore, science is not a truth seeking and fixed in methodology and rule but truth undergoes transformation always. Choice between paradigms is subjective not objective only. Observations are theory-laden that is theory determines and influences what you see as facts, experience or interpret. Similarly, given different cashless products, customers choose to effect transactions with the most convenient.

#### **SECTION IV: KUHN'S PARADIGM AND REVOLUTION IN CASH-LESS PAYMENT SYSTEM**

The financial system of today's world is the product of centuries of scientific revolution and transformation. No economic activities are possible without the transfer of money. In this sense, it can be said that payment systems are one of the most significant social infrastructures (Humphery and Berger, 1990 and Nakajima, 2012). It should be noted that what began as a barter economy moved through a variety of incarnations in reaction to the limitations inherent in the various stages of progress in payment system. Transformations will definitely continue to occur in response to social and technological progress. This progress can be illustrated in terms Kuhn's paradigm shift.

#### **Barter Payment Paradigm**

Barter exchange period can be likened to pre-science stage where exchange was unorganized, crude and uncivilized exchange of goods for goods. As the system grows sophisticated there came a need for better means of exchange that solve the problems of double coincidence of wants, indivisibility of means of exchange, unacceptability of some products, problem of portability etc. Money was not clearly defined, hence, lack of consensus. The influence of Gold Smith in issuing receipts to people who save with him (banking) and in turn issues receipt conferring right to exchange eventually gave rise a new paradigm - paper currency.

#### **Paper Payment paradigm**

This stage is analogous to the normal science since paper currency exchange and means of payment could be seen as the prevailing paradigm where schools of economic theory formed. Government guidelines and planning are entrenched through various Central Banks. Money is here fully defined in terms of functional, empirical/statistical and legal characteristics. Economist and financial experts always thrive towards maintaining and protecting the means of payment to perform its fundamental roles. However, with growth and development in the modern day society, many questions remained unresolved by the paper currency paradigm. Cost of production, processing, transportation and management of paper currency have become some of the major reasons that called for the gradual abandonment of paper currency.

Issues like sophistication in business and increased globalization, quest for efficient monetary policy management have critically undermined the central role of cash based payment system. In developing economies of Africa, Asia and Latin America, risk of theft and robbery, disaster and deterioration of physical cash are some of the glaring anomalies against the paper based-currency.

#### **Crisis**

Over the years, the paper currency and its concomitant problems/anomalies have significantly and persistently resist solution and fails in many scenarios. This has led to the emergence of new models to providing

answers to these surging events. Given, the unresolved inefficiency and sluggish speed in payment using physical cash, economists and financial experts are plunged into serious search to provide solution these problems.

## **Revolution in Payment System**

Consequently, payment systems have shown remarkable change in the past two decades. In the early days, the payments among the banks used to be made by exchanging paper payment instructions, which is called the "paper-based payment system". But, as the volume of payments increased dramatically, it became very difficult to process paper work with paper instructions and manual handling. This has plunged system in to revolutionary stage as contained in the Kuhnian Cycle.

Here, cash-less payment systems promise the elimination of risk associated with physical cash, better macroeconomic management and is increasingly winning support at various levels. This is a scientific and technological progress in payment infrastructure. Most specifically and importantly, the emergence of "Designated-Time Net Settlement" (DTNS), "Real-Time Gross Settlement" (RTGS) and the "Hybrid Technologies" are important revolutions and progress in payment system in the world over (Nakajima, 2012). Paper based currency is significantly fading out in most advanced economies and represents a big wake-up call to developing nations.

## **Paradigm Shift to Cash-less payment system**

The fundamental question is where are we today? The international financial community: The World Bank, Federal Reserve, International Monetary Fund, Bank of International Settlements, and most recently, the BRIC nations (Brazil, Russia, India, China and South Africa) have all sounded the alarm signals. Other developing nations are practically thriving to reduce cash based structures of their economy to cash-less system not to be bystanders in the gestalt switch (David, 2014 and Lee, 2014).

It is an established knowledge that carrying transactions using cash-less instruments such as: credit cards, debit cards, electronic funds transfers, Digital wallets, Point of Sales (POS), Automatic Teller Machine (ATM) etc is efficient compared to the old paradigm of

making transaction with paper currency. Currently, severally technology and communication industries are manufacturing Smartphone and android application and programmes that facilitate payment of goods and services without using physical cash.

It was reported that mobile subscribers in Japan are already paying for purchases with their smart phones by the end of 2010, and reports are saying that more than \$200 billion dollar mobile payment industry will be worth a trillion by 2015 (Lee, 2014). In fact, in a survey recently released shows that 25 % of Australians claim not to use cash in a given month. In the US, 50% of Americans carry less than \$20 in cash at any time (David, 2014).

Nigeria started the implementation of the cash-less policy project on the 1<sup>st</sup> January, 2012 with Lagos state as a pilot state but has extended to all parts of the country by the end of 2014. In Africa, Kenya to be specific, at least three companies are already using the new fare system, which operates in a similar way to London's Oyster card, with passengers pre-loading plastic cards with money and swiping them across a reader on board. Nigeria, South Africa etc are largely implementing cash-less payment policy. Indeed, this is a paradigm shift as Kuhn rightly submitted. The CHIPS of course, is the latest and the most advanced and acceptable of the Hybrid system as a prevailing paradigm. It is apparent and obvious that the processing method of the CHIPS is much more sophisticated, faster and efficient than in the older model (paper currency). This research submits that the world will continue to experience great advancements and progress toward a paperless society.

## **SECTION V: CONCLUSION**

This research examined Thomas Kuhn's philosophy of scientific progress and how it can be used to explain the revolution in payment systems in the world system today. It was shown that scientific theory does not necessarily emerge from linear or straight forward aggregation or accumulation of facts from set of changing intellectual circumstance and possibilities. Paradigm effectively guides science than set of rules and should be given higher priority. It is a fact that evolution in payment system has shown remarkable changes in the past two decades. This research submits that the world will continue to see progress toward a cashless/paperless society, in both the advanced and developing nations. The total

acceptance and adaptation to cash-less payment system would however, significantly depend on the country's specific, cultural, political and socio economic characteristics. As Kuhn noted; there will always be unresolved crisis left by a paradigm. These unaddressed problems in cashless infrastructure could be seen in terms of proliferation of cyber crime, monetary policy control and how to integrate the developing regions in this transformation. Another critical point relates to Christian religious faithful whether the emergence of chips represents the fulfillment of the scriptures? In the United States, the government is attempting to insert Chips in the bodies of her citizens in an attempt to combat crime, migration and other related issues. Is this the appearance of the "mark of the beast? Is the world system in need of newer paradigm of making transactions? Notwithstanding, revolution is a necessarily ingredient and barometer for scientific progress.

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