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The Journey from the Industrial Revolution to the Digital World: Evolution of Transaction Cost Economics

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Abstract

Around eighty-five years ago, the concept of transaction cost was introduced by Coase, and in the early 1980s, transaction cost theory became a part of the new institutional economics research due to the incorporation of cognitive psychology into decision-making. The reach of the digital revolution creates new forms of economic organisation that urge the widening of the boundaries of transaction cost theory. Therefore, this review aims to explore the contextual evolution of the concept of transaction cost from the Industrial Revolution to the Digital World. In addition, this review highlights how the relevant theories emerged and developed in response to the changes around us. Therefore, this review will assist scholars and economic actors in understanding the importance of the theory of transaction costs and suggest applying it in economic endeavours to suit the digital economy for success while meeting the challenges. Further, the review highlights the need for further research to cope with the challenges encountered in digital economic landscaping.

Keywords: Digital World, Industrial Revolution, Opportunism, Transaction Cost Economics

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Introduction

Eighty-five years ago, Coase (1937) presented the transaction cost concept in his 'The Nature of the Firm' thesis. This concept tends to be regarded as the stepping stone in economic analysis with a positive transaction cost. After sixty years, this concept was recognised and awarded the Nobel Prize due to the importance of the role of firms in the functioning of the economy (Coase, 1992). However, as Williamson (1985) noted, the thesis of 'the nature of the firm' use was limited and identified as non-operational as the concept was not incorporated into a theory. Coase (1992) explained that most theories, such as the neoclassical theory of the firm in that era, developed with the assumption of zero transaction cost, which means that economists were conservative with their method.

During the post-war period, the research on institutional economics was minimal and reiterated in the 1970s and early 1980s with the rediscovery of technology-based production. During the late industrial era, the research on new institutional economics reached exponential growth with the criticism of the neoclassical theory of the firm due to idealistic assumptions, such as issues on perfect information about market conditions that were absent in the real world and maximisation of profit (Hardt, 2009). Under these circumstances, economising transaction costs had been incorporated into research on new institutional economics while opening up the black box.

Many scholars (Coase, 1937; Benkler, 2002; Williamson, 1981) gave their interpretation of transaction costs. Williamson (1985) stated that transaction costs are "economically equivalent to friction in the physical system". The physicists assumed the absence of friction and revealed that the physical system's friction was persistent and needed to be considered. However, economists did not appreciate the respective costs of running the economic system that occurred in the real business world (Williamson, 1985). Accordingly, during the early 1980s, a two-way approach was gained while designing an incentive structure to maximise the probability of the firm sustaining and focusing on decision-making within the firm using cognitive psychology.

The digital revolution creates novelty mechanisms in organising economic activities such as user innovations, crowdsourcing, and idea competitions. Benkler (2002, 2016) suggested that the new revolution signifies a collection of new technologies and innovations through artificial intelligence, 3D printing, and the application of biotechnology. These novelty mechanisms expect to merge digital, biological, and physical attributes and are expected to transform our society and

economy into digital form. Accordingly, transaction cost economics is employed like the sharing economy and other emerging transactions such as blockchain and self-manufacturing. Accordingly, the economic actors experience challenges while transforming into new trends of economic activities with technology enhancement.

Peter and Olson (1983) stated that theories have life cycles, modified in response to changing circumstances over time. In compliance with that, the concept of Transaction cost initiated by Coase was further developed by Oliver Williamson and followed by Yohani Benkler to suit with digital world. Accordingly, this review aims to explore the contextual evolution from the Industrial Revolution to the digital world in transaction cost economics, which has hardly been discussed in the existing literature. In addition, this examination highlights how theories emerged and developed over time in response to the changes around us. This examination will assist in understanding the importance of this theory and suggest how to apply it in economic endeavours for success.

Review Method

The resources considered in this examination were chosen from peer-reviewed articles on JSTOR, Science Direct, Springer, and Google Scholar websites. The keywords 'Transaction Costs', 'Transaction Costs Theory', and 'Transaction Cost Economics' were used as a search approach. Based on the literature, the search was conducted in JSTOR, Google Scholar, Science Direct, and Springer databases. Initially, 227 articles were identified, and 138 were selected for screening after removing duplicates, as shown in the PRISMA Flow chart in Figure 01. During the selection of articles, the theoretical perspectives were assessed.

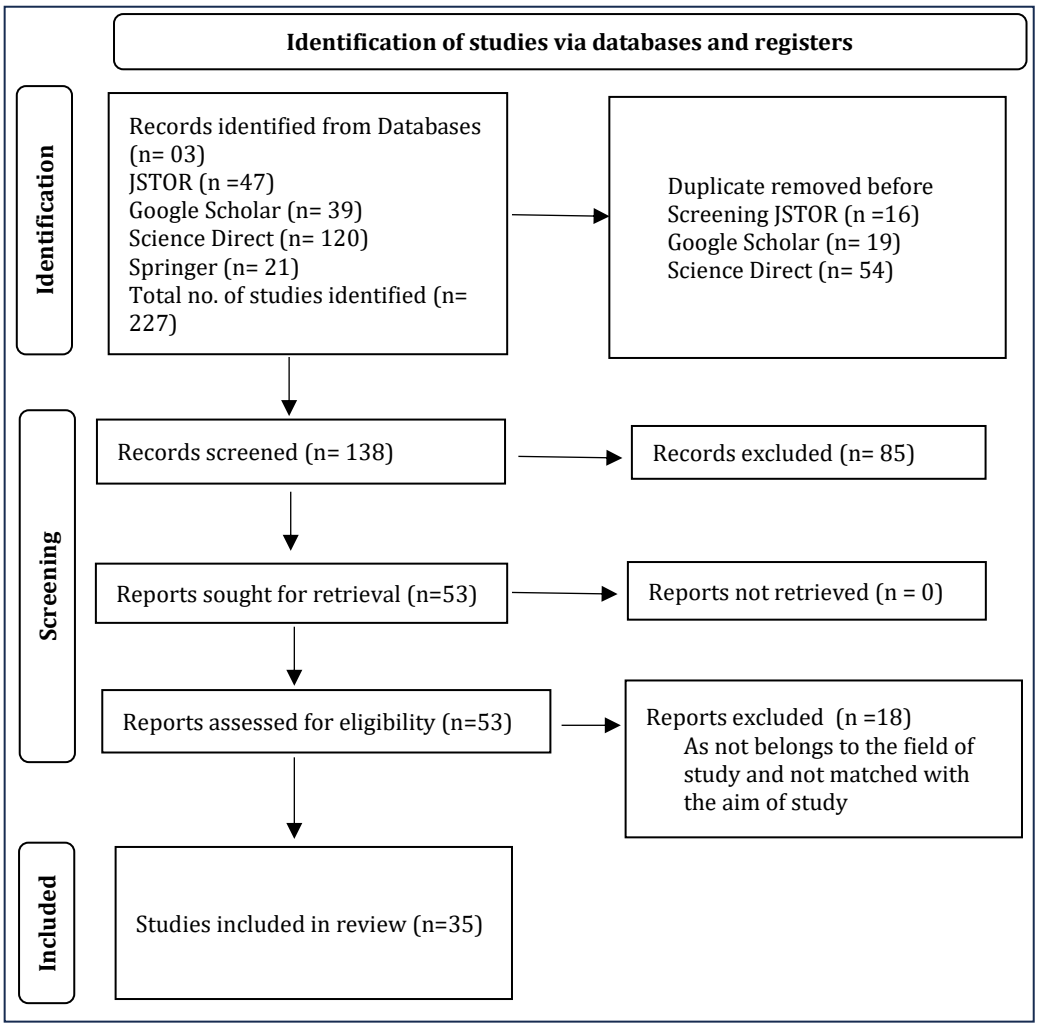
The authors examined each article by reviewing the title, abstract, and keywords, sorted according to the aim of the study while manually removing the duplicates. In the second step, 35 articles were sorted for review after removing unmatched content within the scope of the study. Finally, the review was formulated based on 35 selected articles.

Findings

The study identified three significant developments in transaction cost theory and categorized them as the Early Industrial Era, the Late Industrial Era, and the Digital Era. The transaction cost concept emerged during the early industrial era and was operationalised during the late industrial era. Further, the theory widened its scope to

suit the digital era. Accordingly, the findings were summarised while anchoring the relevant literature on the intellectual transformation of transaction cost economics.

Figure 1: Prisma Flow Chart



Early Industrial Era: Steppingstone to Move from Zero to Positive Transaction Costs

During the early Industrial Revolution, Coase grew up in the United Kingdom observing mass factory-based large-scale production. For example, Ford's factory operated over 12,000 acres employing approximately 100,000 workers. The production exceeded 800 automobiles a day. In compliance with the idea of Weick (1989) theory is mainly developed based on theorists seeking to understand the world

around them, the determinative experience of perceiving large-scale factory production, Coase (1937) formulated his thesis 'Nature of the Firm'. In that, he stated certain limitations on the economic system operated during the period. Assuming that the Firm is a suppression of the pricing mechanism, he proposed that price mechanisms incur costs and can be reduced by organizing transactions through a firm (Coase, 1937). However, his concept was not recognized at that time and began to be widely accepted only after four decades of its initiation.

The supply is adjusted to demand based on human needs, in which the production is for consumption. This process is automatic, elastic, and responsive. Economists during the era believed that the price mechanism coordinated the economic system. Further, they assumed that the price mechanism influences the direction of resources. According to Coase (1937), economists believed that the operation of economic systems is automatic and without central control. He also argued that studying different ways of organizing industries seems to lack any theory and stated that even if the economic system 'works itself', it consists of planning between alternatives. Competition, acting through a pricing system, did the necessary coordination through factors of production and management function.

Coase (1937) argued that the explanation of the economic system was incomplete, and the explanation of the function within the firm did not fit at all. Even though the price mechanism decided the allocation of factors of production between alternatives, it was not applicable in many areas. Coase (1992) stated that economists were not interested in internal arrangements within an organisation and were concerned only with the market situation, purchase of factors of production, and the sale of produced goods. They ignored what happened between the purchase of factors of production and the sale of produced goods. Economic theory described a firm as a black box; even economic systems were employed within a firm in which administrative decisions on how to use resources were made. The efficiency of the economic system mainly depends on the conduct of the organizations. Hence, for the theory to become complete, the determination of the extent of the product done by institutional arrangement needs to be considered. Even ex-communist countries tried to be transformed into a market economy, but it was impossible without appropriate institutions.

Coase (1937) argued that even the coordination function given to the entrepreneur, or manager in the price movement economic system, could not be considered economic planning. If the price mechanism performs the coordination

function, why is organization necessary? Outside the firm, price movement directed production through market transactions. However, market transactions were eliminated within a firm, and the price mechanism was substituted for the entrepreneur coordinator who directed production. The degree of superseding the pricing mechanism varies. The coordination of certain factors of production could be done without the involvement of the price mechanism. For example, the price mechanism was superseded by the degree of vertical integration, which was firm-specific and industry-specific. Ketokivi and Mahoney (2016) stated that firms operate in hierarchies with authority, and efficient and effective resource allocation is observed more than the market.

Assumption of the Firm as Suppression to the Price Mechanism

Coase's classic article 'Nature of the Firm' stated that a firm emerges in an exchange economy due to entrepreneurship. The coordination is either a price mechanism or an entrepreneur (Coase, 1937). In addition, he noted that economizing the transaction cost was the missing factor for explaining why markets or hierarchies were used. Coase (1937) explained that consulting the market price is not required for a firm to transfer a good or service internally from one stage to another because the firm's internal accounting system consists of cost-plus other terms. The firm purchased goods and services from the market by placing orders, with a qualified sole-source external supplier who agreed to sell on certain conditions. The market and firm were considered equivalent in price discovery respects.

Coase (1937) proposed the firm as the suppression of the price mechanism. He stated that pricing mechanisms incur costs, and hence it is profitable to establish a firm and firms emerge due to the transaction costs. The cost incurred in production in the price mechanism determines the relevant prices. This cost cannot be eliminated but can be reduced through the emergence of specialists. The costs incurred for negotiations undertaken, the drawing up of contracts for separate transactions, inspections made, and arrangements for settling disputes to be discovered. These costs are known as transaction costs. Transaction cost is distinguished from production cost and is defined as the cost incurred to run the economic system (Arrow, 1969).

Even though economists assume that the price mechanism decides the distribution of resources in a specialized exchange economy, the firms still exist. This is because firms comprise a system of relationships contingent on the entrepreneurs' direction of resources. Further, Coase (1937) suggested that the firms emerged due to

the presence of marketing costs. In addition, Coase (1937) proposed that firms emerged due to uncertainty and the division of labour. With human nature, it is impracticable to guarantee the definite results of actions. Therefore, the activities of others are monitored directly through contracts with guaranteed wages within a firm.

The existence of firms may reduce contracts, but they cannot be eliminated. Making a contract to employ within a firm with agreed remuneration enables workers to obey the entrepreneur's directions with certain limits. These limits were based on the power of the entrepreneur, with which he can direct the other factors of production. Coase (1937) stated that, within a firm, the entrepreneur could obtain the factors of production at a lower cost to carry out his functions than in the market. Coase (1937) also argued that in a competitive system, firms need optimum planning and can exist when performing their coordination functions at a lower cost than in market transactions or other firms. Therefore, an efficient economic system requires a market and proper planning within the firm with appropriate size.

Coase (1937) proposed that the government or the regulatory bodies were treated differently during transactions through the market or a firm. For instance, sales tax operates in market transactions but not if the same transaction is organised within the firm. In addition, quota schemes and methods of price control not applying to the product produced by firms themselves may encourage the growth of firms as it has an advantage.

The Emergence of the Concept of Transaction Cost.

The transaction cost was introduced by Coase (1937) in 'The Nature of the Firm' when he was twenty-one, in an era in which standard economics theories assumed zero transaction cost. This concept tends to be regarded as the stepping stone in incorporating transaction costs in economic analysis. This concept was recognised by awarding the Nobel Prize sixty years after its initiation, proving the importance of the role of firms in minimising transaction costs (Coase, 1992). Once moving from zero to positive transaction costs, the prime importance is the legal system that individuals possess to act. At certain times, the procedure could be costly with positive transaction costs. Hence, the rights possessed by the individual with their duties and privileges need to be determined which has a thoughtful effect on the economic system (Coase, 1992). As Benkler (2002) stated, Coase introduced a cost associated with enforcing property and contract rights. Further, Coase (1937) introduced the limits of the firm based on the difference in transaction cost while organising transactions either through the firm or the market.

Late Industrial Era: Refinement of TCE by Merging Cognitive Behaviors and Attributes

During the post-war period, the research on institutional economics was minimal and reiterated in the 1970s and early 1980s with the rediscovery of technology-based production. During the late industrial era, the research of new institutional economics achieved exponential growth with the criticism of the neoclassical theory of the firm due to its idealistic assumptions, such as issues on perfect information about market conditions and maximisation of profit (Hardt, 2009). Under these circumstances, Transaction cost economics (TCE) became part of institutional economics research tradition and functional to the study of the economic organisation while opening the black box. A two-way approach was gained while designing an incentive structure to maximise the probability of the firm sustaining and focusing on decision-making within the firm using cognitive psychology. Firms, markets, and relational contracting were the evolutionary products of organisational innovations. Williamson (1985) stated that without economising the transaction cost, an accurate assessment of economic organisation could not be attained. Further, he stated that the study on the approach of TCE was more microanalytic, conscious of the behavioural assumption. Hence, he introduced the concept of asset specificity and relied on relative analysis of institutions. In addition, the firm was taken as a governance structure instead of a production function.

Williamson (2010a) acknowledges that the puzzle posed by Coase in 1937 was the specific issue that initiated the research project. Williamson (1985) stated that transaction costs are economically equivalent to the friction in the physical system. The physicists assumed the absence of friction, and later, they accepted the presence of friction in the physical systems and took it into account. However, the economists did not consider the respective cost of running the economic system (Williamson, 1985). The negligence of these costs has caused numerous complications in economic organisations, creating the possibility of non-standard contracting practices such as monopoly, price discrimination, and entry barriers (Coase, 1972).

Economic organisation has a problem of contracting which can be organised explicitly or implicitly. Usually, transaction costs are categorised into two types: ex-ante and ex-post. The costs incurred for drafting a contract, negotiating transactions, and required safeguarding of the agreement are categorised as ex-ante. The costs incurred due to maladaptation, bargaining, handling disputes, and bonding are categorised as ex-post (Williamson, 1985). Ex ante transaction cost occurred during the drafting of a complex contract document, which must be done with great care.

Proper drafting of the contract avoids numerous contingencies and stipulates suitable revisions by parties agreed in advance to avoid an incomplete contract. In case of incomplete contracts, the respective parties must fill the gaps once the contingencies arise. Several forms of safeguards are used, the most obvious is common ownership. Once the parties experience contracting difficulties, parties substitute internal organisations into the market. The ex-ante inter-firm safeguards might cause credible commitment and maintain the integrity of the transaction. Most studies assume that in case of contract disputes, the rule of law applied by courts was sophisticated and low cost. Ex-post transaction cost has several forms: maladaptation cost when transactions drift out of alignment, haggling (negotiation) cost for efforts made to correct misalignment, costs associated with governance structure in case of disputes, and bonding cost affecting secure commitments (Williamson, 1985).

Merge of Cognitive Behaviours

Williamson (1981) introduces two behavioural assumptions in the study of economic organisation. First, Williamson (1981) mentioned that human agents are subject to bounded rationality. According to Williamson (1985), bounded rationality was the appropriate cognitive assumption for the study of complex contracts that were unavoidably incomplete. Second, Williamson (1981) proposed opportunism, a condition where self-interest is sought with guile. Even Perrow (1986) stated that most people in most of the time tend to lie, cheat, and steal. Williamson's TCE assumed that certain actors behave opportunistically at certain times which was difficult to identify and needed precautionary measures to eliminate the breakdown of transactions. Most scholars argued that trust (Goodwill type) could be effective in safeguarding by reducing or eliminating the threat stemming from opportunism (Cuypers et al., 2019).

Merge of Dimensions into Transaction Cost Economics

Williamson (1985) noted that transaction costs are economised by assigning transactions which differ in their attributes to governing structure in a discriminating way, and proposed considering the transaction as the basic unit in economic analysis. Williamson (1979) stated that autonomous trading will be disturbed with bounded rationality and opportunism. In contrast, effective autonomous contracting resulted in effective ex-ante and ex-post competition. The effective ex-ante condition is easy to satisfy as there are many qualified bidders. Consequently, the exchange relation will be transformed to small numbers during the execution of the contract, limiting the ex-post competition. As the effectiveness or failure of completion of the contract depends

on the characteristics of the transaction, Williamson (1981) proposed three dimensions of transaction: asset specificity, uncertainty, and frequency.

Asset Specificity

Williamson (1981) stated that asset specificity was neglected by past scholars even though it is the most important attribute in transactions. Asset specificity refers to the degree to which investments tailored for a specific transaction hold greater value within that transaction than if they were redeployed for alternative uses. In the case of unspecialized items, buyers can easily turn to alternative sources, and suppliers can sell their products from one buyer to another without difficulty. However, in specialized (Specific) investments to particular transactions, the situation is completely different. David and Han (2004), state that a greater level of asset specificity is associated with hierarchical governance. Williamson (1985) explained a variety of contracting outcomes to facilitate comparative institutional analysis based on whether the supply supplier uses general purpose or special purpose technology, supplying with a protective safeguard or without a safeguard, as shown in Table 1.

Table 1: Contracting Outcomes

Status	The kind of Technology used in the transaction	Presence of Contractual Governance (Safeguards)	Contractual outcome
A	Use general-purpose technology in transaction	No protective governance structure	The discrete market serves and competition obtains. The breakeven price of supply is P_1
B	Transaction Specific investment made	No protective Governance structure	Unstable contract. The contract may revert to either A (Converting general purpose technology) or C (introducing contractual safeguard). The breakeven supply price is P_2. ($P_2>p_1$)
C	Transaction specific investment made	Protective governance structure is present	Protected against expropriation hazards. The breakeven supply price is P_3. ($P_2>P_3>P_1$)

Source: Based on information from Williamson (1985)

Uncertainty

Uncertainty is present from intermediate to high degree in most transactions. Williamson (1979) stated that market transactions take place irrespective of the degree of uncertainty and differently in transaction-specific investments. Uncertainty is the inability to predict environmental changes and one another's behaviour under unforeseen circumstances. Uncertainty is common, inescapable, and requires adaptation.

Frequency

The frequency means the volume of transactions between the two exchange parties or the amount of transactions that repeat (Williamson, 1985). The overhead cost of more frequently recurring transactions in hierarchical governance is easier to recover than less recurring transactions.

Impact of Opportunism, Bounded Rationality, and Asset Specificity

Economising costs in an organisation has two main concerns: economising production costs and economising transaction costs. Economising transaction costs will reduce the impact of bounded rationality and facilitate protecting the transactions against opportunism. Williamson (1985) described a contract as planning, promise, competition, and governance and is dependent on behavioral assumptions. Accordingly, Williamson (1985) explained four different contracting models based on the conditions shown in Table 2.

Distinguishing Governance Structures

Williamson (1979) highlighted three governance structures. The first is non-transaction-specific, the second is semi-specific, and the third is highly specific. The market is a nonspecific governance structure where buyers and sellers meet and exchange goods and services at an equilibrium price. The market is effective in recurrent transactions as both parties are concerned about their own experiences to continue their trading relationship. The highly specific governance structure is made-to-order to the specific desires of the transaction. Semi-specific governance structures are in between the non-specific and highly specific. In transaction-specific governance, Williamson (1979) further distinguished into two types; mixed (bilateral governance) and highly specific (unified governance). A bilateral structure maintained in highly idiosyncratic transactions in which production requires highly specific human and physical assets. In unified Governance (Internal Organization), transactions become more idiosyncratic as human and physical assets become more specialised to single-use and less transferable. Even though Williamson (1981, 1985)

successfully made empirical verification and the universalisation of transaction cost theory, certain critiques were made by scholars such as Hardt (2009) and Foss and Weber (2016) highlighting the absence of incorporation of Knowledge into the theory. However, with the reach of the digital world, Benkler (2002) urges the requirement of widening the boundaries of transaction cost theory to suit the digital world, as explained in the following section.

Table 2: Different Contracting Models

Model	State of attributes	Implied contracting process	Explanation
01	Opportunistic partners, asset-specific investment, and absence of bounded rationalities	Planning	The contract is based on private information. Issues are settled at the bargaining stage. Comprehensive bargaining is done at the beginning and fully described with appropriate adaptation to subsequent contingent events.
02	Parties are subjected to bounded rationality; the investment is asset-specific. Absence of opportunism	Promise	Gaps might be in contracts due to bounded rationality. Parties initiate to perform the contract efficiently at the beginning in a joint profit-maximized manner while seeking only reasonable earnings.
03	Parties are opportunistic and subjected to bounded rationality. Absence of asset specificity	Competition	No interest in continuing contracts and discrete market contracting is effective.
04	Parties are opportunistic, subjected to bounded rationality and investments are asset-specific	Governance	Planning is incomplete due to the presence of bounded rationality. Promise will be broken down due to the opportunism. Pairwise identity exists due to asset specificity.

Source: Based on the explanation by Williamson (1985)

Digital Era: Transformation to Digital World

Benkler (2002) stated that Coase originated the transaction costs theory of the firm that provided the methodological template for the positive analysis of peer production they offer. Accordingly, Benkler (2002) highlighted that the initiative of the development of free software threatens organisational theory. The reach of a

millennium creates new types of economic arrangements and transactions. Under these circumstances, the concept of markets vs firms becomes challenging. Benkler's TCE mainly focused on technology and widened Coase's and Williamson's perspectives. With the influence of the technology of the digital age, Yochai Benkler modernised the TCE in response to the digital world (Rindfleish, 2019).

The development of free software projects has no relation to the market or hierarchies of management while organising production. With the new millennium, Benkler (2002) noted the requirements of expanding the boundaries of TCE to incorporate the role of technology with the initiatives of digital revolution. Organising economic activities with the digital revolution creates new mechanisms such as crowdsourcing, idea competitions, and user innovation led by the internet (Benkler, 2002, 2016). Hence, people seek economic functions in nonmarket models with the prevailing social movement.

Benkler (2002, 2016) suggested that in the Digital Era, most people are highly motivated by non-monitory rewards such as social recognition that can be attained through the collaborative production of Goods and services. Therefore, Benkler (2002, 2016) proposed that this social production through information-based contributions is vastly popularising as an alternative mechanism for firm or market-based production. This new revolution signifies an assembly of new technologies, such as biotechnology, artificial intelligence, and 3D printing. This technology incorporation amalgamates digital, biological, and physical attributes that transform economic and social activities to reduce firm-based manufacturing and supply chains. Further, these digital initiatives facilitate individuals to self-manufacture a variety of products.

Peer-to-peer production has emerged from internet-based social practices (Benkler, 2021). This initiative is a social motivation that is decentralised, and without a third party playing, two individuals interact with each other. Thus, the boundaries of TCE could be widened to understand the nature of the sharing economy and other emerging new forms of transactions, such as self-manufacturing blockchain transactions. The blockchain enables conducting complex tasks by tracking and verifying transactions through loosely connected individuals rather than formal organisations.

Accordingly, with new initiatives, firms were under pressure due to collapsing transaction costs. Peer production has comparative advantages in collaborative

innovation and information production either through an organisational or institutional mechanism. This peer production brings diverse motivations and creativity through diverse individuals. Even though the new technology incurs the cost of communications, it distributes necessary knowledge and allows individuals to share designs and incremental improvements, enabling the amalgamation of their knowledge and resources. In addition, this peer production coordinates action on shared goals without a firm or markets. Peer production uses online high and low-skill-level labor markets to solve problems and innovations that experience uncertainty proving the requirement of the existence of a firm (Benkler, 2002). However, the role of the firm should not be confined and proposed to reorient their strategies to pursue knowledge-based unique advantage. Hence, Benkler (2002, 2016) suggested that firms are required only to maintain social integrity and motivational diversity. Motivational diversity is combining talented individuals who have diverse motivations and interests in managing a dedicated balance. Social integrity is the subscription of a shared identity and mutual recognition that keeps teams as persistent learning networks. As Benkler (2002) stated, peer production combines three core characteristics. One is the decentralisation of commencement, implementation of problems, and solutions. The second is combining various inspirations, and the third is deviating governance and management from property and contract. Accordingly, Benkelr (2016) suggested a combination of TCE with the distinct characteristics of dependence on governance, the significance of nonmonetary rewards, and the permeation of the boundaries of the firm.

Benkler (2016) stated that when transactions are organised through social production, they need to have high levels of modularity and granularity. Modularity is the property of a project which could split into smaller components or modules. These modules should have been independently produced before assembling into a whole. The granularity is the modules' size, which an individual must invest in producing in terms of time and effort (Benkler, 2002). The modular and granular products facilitate thousands of individuals across the globe who can contribute innovations to collective production with minimal effort, time, and costs. Under these circumstances, it enables to pool efforts of different people processing diverse capacities and capabilities available at different times throughout the globe. Accordingly, employing quality control over modules and successfully integrating modules will make a finished product at a lower cost. Benkler (2002) suggests that both market and firm are part of a broader market system. It can be competitive and motivated by monetary rewards. Further, Benkler (2002) proposed a third model distinct from market and firm, which identifies the advantage of human capital.

Further, he elaborates that the availability of a universal computer network can attain production very cheaply and faster than human capital.

Gaps in the Extant Literature and Directions for Future Research

During the early industrial era, with the exposure of large-scale factory-based production, Coase (1937) introduced the classic article 'Nature of the Firm' and noted that a firm emerges in an exchange economy due to entrepreneurship. In addition, he stated that economising the transaction cost was the missing factor for explaining why markets or hierarchies were used. When firms exist, they can reduce the contracts but can't eliminate them. Coase (1937) argued that in a competitive system, firms need optimum planning and can exist when performing their coordination functions at a lower cost than in market transactions or with another firm. Therefore, an efficient economic system requires a market and proper planning within a firm of appropriate size.

During the late industrial era, with the rediscovery of technology-based production, the research of new institutional economics reached exponential growth with the criticism of the neoclassical theory of the firm due to its idealistic assumptions, such as perfect information about market conditions and profit-maximising. Under these circumstances, Transaction cost economics became a part of institutional economics research tradition and functional to the study of the economic organisation while opening up of black box. Accordingly, Williamson (1979) stated that without economising the transaction cost, an accurate assessment of economic organisation could not be attained. Based on the concept of transaction cost introduced by Coase (1937), Williamson (1979, 1985) noted that the thesis of the 'Nature of the Firm' was not popularised and identified as nonoperational as it had not been merged into a theory. Hence, Williamson (1981,1985) offered a further step ahead through his empirical analysis. Accordingly, Williamson (1981,1985) introduced an incentive structure to maximise the probability of sustaining the firm by focusing on decision-making within a firm using cognitive psychology. Williamson (1979) introduced four contracting outcomes: planning, promise, competition, and governance. Firms, markets, and relational contracting (Hybrid) were the evolutionary products of organisational innovations (Williamson, 2010b). Based on the empirical analysis, Williamson (1979, 1985) introduced two assumptions: opportunism and bounded rationality. Further, he introduced three dimensions; asset specificity, uncertainty, and frequency to fill deficiencies in the description of a transaction cost (Williamson, 1979). Hardt (2009) also noted that 'The Nature of the Firm' did not explain the reasons for the costs incurred in market

transactions, did not give any operational measures of transaction costs, and did not explain the relationship between institutions and transaction costs.

With the reach of the digital era, certain scholars have criticised Williamson's views. Hardt (2009) argued that the way of organising transactions depends only on asset specificity, uncertainty, and frequency. It does not provide a basis for knowledge while emerging organisational forms. In addition, Nickerson et al. (2004) noted that Williamson's governance approach lacked in incorporating the knowledge and capabilities on how to organise transactions efficiently. Further, Foss and Weber (2016) stated that economising bounded rationality has two dimensions. One is heuristic problem-solving, and the second is the discriminant alignment of governance structures. Williamson's TEC argument comprised only one approach in assigning transactions to the governance structure in a discriminated way (Williamson, 1985). The discriminant alignment of governance structure explains the limitation of processing capacity. The heuristic problem-solving explains cognitive economising and cognitive biases (Simon, 1990) and is missing in Williamson's explanation of bounded rationality. Simon (1990) explained 'Cognitive economising' as the use of approximate methods to handle most tasks due to the limitation of computing speed. Therefore, the strategies resulting from preceding knowledge with similar problems (heuristics) are highly functional in making decisions in a complex world (Gigerenzer, 2003). The 'cognitive biases' explain that even the heuristics assist in decision-making can cause wrong decisions. Williamson stated in compliance with contending perspectives, that transaction cost theory offers a comparative advantage based on empirical evidence. Further, he accepts that TCE needs to be more 'dynamic' and should emerge beyond governance (Williamson, 1999).

Benkler (2016) suggested that in the Digital Era, most people are highly motivated by non-monitory rewards, such as social recognition that can be attained through the collaborative production of goods and services. Therefore, Benkler (2002) proposed that this social production through information-based contributions is vastly popularised as an alternative mechanism for firm or market-based production. This new revolution signifies an assembly of new technologies, such as biotechnology, artificial intelligence, and 3D printing. This incorporation of technology amalgamates digital, biological, and physical attributes that transform economic and social activities to reduce firm-based manufacturing and supply chains. Further, these digital initiatives facilitate individuals to self-manufacture a variety of products.

Currently, the digital economy is the main driver of economic growth in many countries, and it continuously develops due to digital technologies and their impact on economic and business activities. As Xia et al. (2023) stated, the use of digital technologies through electronic communications creates a noteworthy shift towards online business interactions. It enhances processing and digitalisation, which entails user experiences and easy access to services and products. The use of these new technologies might create many threats, such as the risk of fraud and the invasion of privacy. However, new technology creates a gradual reduction of costs for coordinating and monitoring transactions which is a concern in TCE. Beyond Williamson's version of TCE, the use of artificial intelligence and blockchains with online review and reputation mechanisms, opportunistic behaviour is risky and becomes a difficult endeavor.

The use of technology and electronic communications has diverged the global economy towards digitalisation and continues to increase in the future. Rosário and Dias (2023) stated that the digital economy promotes resource conservation through products that use recycled materials and reduce waste. Further, the digital economy contributes to a circular economy that permits transparency and accountability while reducing opportunism and bounded rationality highlighted by Williamson (1981, 1985). Therefore, future research is needed on the successful implementation of the digital economy in the current world. In addition, further research is needed to identify and propose strategies to meet the challenges in the digital economy. As an example, high energy consumption creates pollution due to e-waste and expanding carbon emissions. In addition, challenges might emerge, such as inequality and the digital divide, job insecurity, the concentration of power among a few large corporations, and data protection and privacy. Therefore, economic actors must consider these issues that enable the optimal use of the opportunities presented in the digital economy to promote sustainability in the future.

The intellectual contributions made by scholars; Coase (1937), Williamson (1979, 1981, 1985), and Bankler (2002, 2016) are summarised in Table 3.

Table 3: Summary of the Intellectual Contributions

	Coase (1937)	**Williamson (1979, 1981, 1985)**	**Benkler (2002, 2017)**
Main idea	Introduction of Transaction cost as the missing factor in	Introduction of Cognitive hypothesis and	Incorporation of technology while widening the

	Coase (1937)	Williamson (1979, 1981, 1985)	Benkler (2002, 2017)
	the emergence of the Firm	attributes of the transaction	boundaries of transaction cost
Introduction of Economic Organization	Market and Firm	Market, Firm, and relational contracts (Hybrid)	Social production through information-based contributions
Limitations identified	1. Does not explain why transaction costs incur. 2. Does not give any operational measures of transaction costs 3. Does not explain the relationship between institutions and transaction costs	1. Not concerned about Knowledge 2. Not concerned with cognitive economising and cognitive biases	1. Inequality and the digital divide, job insecurity, the concentration of power among a few large corporations, 2. Data protection and privacy issues
Views on Human motive	Not identified Opportunism in Transaction	Opportunism is most vital	Enthusiastic to act in either selfish or social motives
Role of Technology / Knowledge	Silent	The choice between firm, hybrid, and market organisation determined by technology	The main factor in the transaction is technology

Conclusion

The development of a theory is a sensemaking process based on understanding the world around us. In compliance with that, Coase pursued experience of transactions increasingly conducted in large-scale factory-based production. After about 40 years, Williamson explained the economic activities in the late industrial era that produced complex firm and interfirm structures. Benkler pursued the emergence of crowdsourcing and peer-to-peer production incorporating technology. According to this sensemaking process, these theorists developed their experiences to interpret the economic transactions around them while economising transaction costs.

This paper first highlighted the weakness identified in economic transactions by Ronald Coase during the early industrial era and placed the stepping stone to replace the neoclassical theory of the firm by introducing the presence of transaction costs in

transactions. He argued that economising the transaction cost was the missing factor for explaining why markets or hierarchies were used. Thereafter, this paper highlighted enhancement made by Oliver Williamson while introducing cognitive aspects, opportunism, and bounded rationality, and introducing three attributes: asset specificity, uncertainty, and frequency to fill the deficiencies identified in the description of transactions to operationalise the concept. Finally, the paper highlighted Yohani Benkler's view on identifying a requirement to widen the boundaries of transaction cost theory to suit the digital economy.

As Peter and Olson (1983) said, theories have life cycles modified in response to changing circumstances over time. Hence, this paper attempts to highlight the need for economic actors to look at the developments in today's technological, social, and economic landscape in their economic endeavour to attain success in the competitive environment. This new revolution signifies an assembly of new technologies, that amalgamate digital, biological, and physical attributes that transform economic and social activities to reduce firm-based manufacturing and supply chains.

Hence, this paper highlighted that the digital transformation of the economy plays a crucial role in sharing goods and services through peer-to-peer production, promoting resource conservation, and allowing transparency and accountability. Meanwhile, this paper concludes by urging the requirement of future research while adopting a digital economy that creates certain challenging circumstances. Hence, researchers need to consider how to cope with e-waste generation and high energy consumption while creating job insecurity. Further, the concentration of market power among a few large-scale corporations, data protection issues, and privacy concerns are the themes that economic actors and scholars should consider in their future activities and research.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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