

Study of Technology, Ownership and Reputations in an Outcome-based Contract

A thesis submitted to the

UPES

For the award of

Doctor of Philosophy

In

General Management

By

Ramesh Kumar Shanmugam

December 2024

SUPERVISOR(s)

Dr Anita Sengar

Dr Tarun Dhingra



Department of Business Studies, Strategy and Leadership

School of Business (SOB)

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Ramesh Kumar Shanmugam
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Internal Supervisor

Dr Anita Sengar

Associate Professor

Department of Business Studies, Strategy and Leadership
School of Business, UPES

External Supervisor

Dr Tarun Dhingra

Professor

Jindal School of Banking & Finance
O P Jindal Global University, Sonapat, Haryana



**School of Business (SOB)
UPES
Dehradun- 248007: Uttarakhand**

DECLARATION

I declare that the thesis entitled **Study of Technology, Ownership and Reputations in an Outcome-based Contract** has been prepared by me under the guidance of Dr Anita Sengar, Associate Professor, School of Business, UPES. No part of this thesis has formed the basis for the award of any degree or fellowship previously.



Ramesh Kumar Shanmugam

School of Business [SOB],

UPES

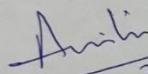
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22/04/2024
Dr Anita Sengar
School of Business,
University of Petroleum & Energy Studies
Dehradun -248007, Uttarakhand

Date 22/04/2024

Energy Acres: Bidholi Via Prem Nagar, Dehradun - 248 007 (Uttarakhand), India, T: +91 135 2770137, 2776053/54/91, 2776201, M: 9997799474, F: +91 135 2776090/95
Knowledge Acres: Kandoli Via Prem Nagar, Dehradun - 248 007 (Uttarakhand), India, M: +91 8171979021/2/3, 7060111775

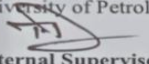
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External Supervisor
Dr. Tarun Dhingra
Professor -Jindal School of Banking & Finance
O.P. Jindal Global University (JGU)
[Email: tarun.dhingra@jgu.edu.in](mailto:tarun.dhingra@jgu.edu.in) Web: www.jgu.edu.in
University Campus: Sonipat Narela Road, Near Jagdishpur Village,
SONIPAT – 131 001. (Haryana) India


O.P. Jindal Global University
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www.jsbf.edu.in; www.jgu.edu.in

ABSTRACT

An outcome-based contract (OBC) delivers committed business results in cost or revenue via the supplied service bundle. The OBCs in information technology and software services have attracted attention in practice, but theoretical and empirical literature is scarce. The OBC phenomenon involves a provider substituting an internal function of a customer with the risks hitherto owned by him. Firm theoretically, the potential contract inefficiencies associated with the OBCs such as costly coordinated adaptations, outcome uncertainties, strategic behaviour due to asset specificity and complementary assets entail hierarchy as the most efficient form of governance. However, the practice moves forward with interfirm/hybrid contracts by leveraging technologies such as automation and digital transformation. This is a reflection of corporate strategy literature which finds the current theories of firms insufficient to explain complex and technology-dependent phenomena. The literature calls for multi-theoretical frameworks to adequately analyse, synthesize, and predict phenomena such as OBCs. By keeping the OBC as the focal phenomenon, this study fills this gap with a conceptual framework which unifies perspectives from three theories under the lens of contract - property rights theory, transaction cost economics, and reputation theory. This three-dimensional analysis integrates technology assets, ownership, and reputations to explain investment incentives and safeguards in the interfirm OBCs. This framework is used to generate propositions by relating technology assets, ownership and reputations in ex-post, ex-ante and time perspectives specialized by the constituent theories. Propositions are used to answer the following key research questions: RQ1. What are the implications of reputation over the ownership of automation and digital transformation assets? RQ2. Why would an interfirm contract emerge as the optimal governance structure for OBCs when firm theories predict internalization? RQ3. How do intra-firm and inter-firm reputations interact and influence OBC services?

A mixed method with a simulation-based quantitative method and an open-ended essay questions-based qualitative method is used to test the propositions. The uncertain outcome and strategic behaviour inherent in an OBC reflect the stochastic and game-theoretic nature of the phenomenon. Hence the problem is formulated as a concurrent stochastic game for simulation in PRISM and PRISM-games probabilistic model checker and simulator. The functional forms of assets of the

contracting parties are defined as player behaviour. The reputation function is modelled as a Fermi probability distribution. Testing of the propositions revealed mainly that (i) assets in an OBC are complementary; (ii) joint ownership is desirable if reputation effects are present, and (iii) the reputation of the contracting parties transfers in the same direction. The qualitative study revealed that: (i) the current practice prefers revenue & risk sharing (RRS) and allocation of technology asset ownership to the provider; (ii) this preference for individual ownership explains the customers' concern about the loss of control; (iii) RRS and joint ownership is the optimal combination for incentives and safeguards; (iv) data weakly supports interfirm reputation flow. The main revelation of the integrated findings from both methods are (i) joint ownership with RRS better reflects the OBC objective though veto rights are uncommon, and (ii) the combination of individual ownership and ownership of incremental project assets is the preferred structure in practice with outside options as key incentive to invest. The study also suggests contracting strategies for predicted equilibria as a function of the firm reputation, dynamism of the contracted work, and technology/industry maturity.

The main theoretical contributions from this study are (i) advancing firm theory with a robust framework that provides a unified view to study technology-dependent phenomena from latitudinal and longitudinal contract dimensions; (ii) derivation of joint ownership, considered suboptimal by theories of firms, as a structural solution to the OBCs to minimize efficiency losses and maximise joint welfare; (iii) deepening understanding of how firm reputation is determined by technology asset ownership; and (iv) demonstration of learning in stochastic games (reinforcement learning) and probabilistic model checking in modelling and generating insights into contract phenomena.

The implications for practice include (i) devising OBC delivery strategies as a virtuous cycle of increasing economic benefits by exploiting reputation and dynamic allocation of ownership to automation and digital transformation assets; (ii) positioning OBC as a joint ownership phenomenon to realize hitherto unrealizable outcome at customer side and a sustenance strategy to shift away from effort-based models; (iii) strategic planning of investments in automation and digital transformation by integrating firm reputation, technology lifecycle and ownership

allocation; and (iv) using of the proposed reputation function to compute contractable outcome from currently realized outcome which often considered as challenging in contract negotiation. The study concludes with potential consequences from the proposed conceptual framework including a systematic approach to design autonomous applications.

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LIST OF ABBREVIATIONS

AA	AI-powered Automation
AI	Artificial Intelligence
aOBC	availability-based outcome contract
CSG	Concurrent Stochastic Games
DCP	Data Collection Protocol
DT	Digital Transformation
eOBC	economic benefit-based outcome contract
ITO	IT Outsourcing
ITS	Information Technology and Software
MC	Mutual Cooperation
MD	Mutual Defection
MRO	Maintenance, Repair and Overhaul
MSC	Managed Services Contract
OBC	Outcome-based contracts
P	Punishment payoff
PBC	Performance-based contracts
PDG	Prisoner's Dilemma Game
PMC	Probabilistic Model Checking
PRT	Property Rights Theory
R	Reward payoff
RRS	Revenue & Risk sharing
SHG	Stag Hunt Game
SMC	Statistical Model Checking

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Appendix A. Data collection protocol

1. INTRODUCTION

“Anything you are good at contributes to happiness.”

- *Bertrand Russell*

The existing effort-based model in the information technology sector (henceforth “the ITS”) is disrupted by increasing demand for business outcomes and share of the automation in the service function (Shankar, 2018). The outcome-based contract (henceforth, “the OBC”) delivers software applications the use of which lead to business outcomes such as lowered cost or enhanced revenue (Francisco, 2023; P. Gill, 2020). The OBCs are emerging as an alternative contract model.

1.1 BACKGROUND

The OBC phenomenon came to prominence with the introduction of “Power-by-the-hour®” from Rolls-Royce in which customers pay for the engine hours used (Green et al., 2017). Rolls-Royce followed this up with “Total Care contracts” by guaranteeing the engine’s availability and reliability. John Deere entered into outcome-based contracts by increasing the productivity of its ploughing machines by using iGuide technology (Ng et al., 2009, 2013). Bombardier and Hitachi came out with “train as a service”, and Caterpillar introduced a similar offering based on outcome-based pricing models (Visnjic et al., 2017).

Similar service demands have started appearing in the ITS sector. Providers attempt to meet the contract objectives by using Artificial Intelligence (AI)-powered automation assets (henceforth, “AA”) and digital transformation (henceforth, “DT”). Business leaders from ITS firms view OBCs as a sustenance strategy against reduced labour component and increased bots component in the value chain (Shankar, 2018). The leaders view AA and DT as efficiency levers to execute OBCs and hence focus exclusively on them (Aggarwal, 2018; Cornell, 2020). Yang Yuanqing, Chairperson and CEO, of Lenovo, summed up the industry that the pandemic has accelerated the

transition to outcome-based services due to the flexibility and agility offered (Milanesi, 2022). The enterprises prefer *trusted partners* for such contracts.

Some examples of the OBCs in the ITS sector are the provisioning of ATM infrastructure to Citibank by TCL, data analysis infrastructure by Owkin to Bristol Meyers Squibb for faster drug development, delivery process improvement to FedEx Supply Chain by Dell, business process automation by IOpex to its customers, prediction of tax evasive transactions by LTI to Department of Income Tax, India and nearby demand predictions by Centricity to retail chains (Awasthy & Hazra, 2020; Castellanos, 2021; Frydinger et al., 2019; Kuchler & Cookson, 2022; Moore, 2021; Seth, 2016). Accenture agrees to receive payments of 10-15% of the contract value as a function of the contracted outcome (Schadler, 2022). Accenture leverages the myWizard platform and digital technologies to transform its customers to implement new business models and revenue streams (Accenture, 2023). Capgemini uses its platform D-GEM in account receivables and payables, and ESOAR solutions to model finance transformation solutions (Champaneri & Gupta, 2022).

While the analysts look for execution capability in the OBCs, the available evidence indicates that ITS firms are hesitant and not eager. In the finance and accounting solution space, Cognizant, Wipro and HCL have a small client base, and Datamatics with no such client base (Champaneri & Gupta, 2022). The current market situation indicates that there is a lack of reputation in OBC execution. Most firms rely on effort-based models, but their customers pressure them for a different pricing model post-stabilization phase. Gartner has found that firms understand the importance of messaging in business outcomes (Healey & Buckley, 2018). Gartner considers the OBCs as a journey based on relationship maturity, strong governance, and transparency in vision and strategy. Goldman Sachs recommends that Indian companies adapt to the OBCs and realize the potential of doubling their market share (P. Gill, 2020). Infosys is cautious that the providers need greater control and industry knowledge to disproportionate risks in the OBCs (Infosys, 2018).

The aforementioned business situation propounds the opportunities in the OBC space and the acquisition of early advantage in the components concerning technology and reputation. However,

there is a lack of understanding of the properties of these components, and how these properties can overcome the contract inefficiencies and realize the contracted outcomes. This study explains the behaviour of the OBC phenomenon with known components, looks for new components for unaccounted behaviour and deduces predictions relating to these components. This study intends to establish a research path in this new generation of contracts.

1.2 DEFINITIONS

IT Outsourcing Contracts

- Resource requirements in terms of manpower quantity & certifications, networks, hardware, software, and other resources.
- Fixed price or cost-plus contracts as a function of headcount, hours, function points, size, and complexity.

Managed Services Contracts

- Guaranteed uptime and service response times to IT resources (servers, networks, applications, and other productive resources.).

Outcome-based contracts

- Value co-creation such as increased revenue and reduced cost by jointly using resources supplied by the providers and assets of the customers (Choi & Cummings, 2016; Ng & Ding, 2010).
- Parties face outcome uncertainty due to the need for joint effort (Grubic & Jennions, 2018).
- Exogenous forces such as government policies are other sources of uncertainty (Essig et al., 2016; Lazzarini et al., 2021).
- Value created needs to be shared among the parties (Cao et al., 2012).
- The OBCs are used interchangeably with value/ performance-based and gainsharing contracts.

Automation assets

- AI-powered application platforms that capitalize decision and prediction tasks, and act as substitutes for human agents (Acemoglu & Restrepo, 2018a; Agrawal et al., 2018a; Dwivedi, Hughes, et al., 2021).
- Providers invest in automation products or platforms as physical assets (Castellanos, 2021; Champaneri & Gupta, 2022).

Digital transformation capabilities

- Involves implementation of ITS solutions involving IoT, to improve efficiency in business performance (Vial, 2019).
- Providers invest in human assets to develop execution capabilities in these technologies.

Through the above definition, this study differentiates capital-based automation from labour-based digital transformation as treated in technological change literature (Acemoglu et al., 2021; Acemoglu & Restrepo, 2020).

1.3 TOPIC AND PURPOSE

Indian IT firms came to prominence in 1997 with the rise in Year 2000 compliance and code fixing services. The industry quickly adapted to increases in contract size, length, scope, complexity, and proportion under offshore execution. They adapted to the technological changes – from varying server platforms to client-server architecture, clouds, AI, and digital transformation. Starting from 1997, the researcher has acquired expertise in IT contracts and developed insights into the dynamics at all the dimensions of contracts. He has made decisions related to contract task lists, resource allocation, pricing, and revenue appropriation. The difficulty in appropriating rents due to ambiguous requirements or responding to unforeseen *contingencies* is a challenge for every IT firm. This is the case even in highly mature contracts. The ITS firms are currently involved in the peripheral operations of the customer production function. The scope of work is separable with clear boundaries. In this context, how a firm can operate in an OBC opportunity which requires

investment in customer assets, consequential adaptations, and sharing of private information was a riddle for the researcher. In addition, the 2016 Nobel Prize awarded to industrial organization economists and contract theorists, Oliver Hart and Bengt Holmstrom, fueled the motivation of this researcher (Nobel Prize Outreach, 2016). The researcher wanted to utilize this opportunity for his long-drawn desire to research and make a contribution to the practice.

A contract being the focus, range of the literature review includes outsourcing, risk mitigation by technologies, and theories under the lens of contract including the theory of reputation (Williamson, 1985, 2002b). The review includes *reputations in repeated games* as the contract involves multi-year relationships (Kreps & Wilson, 1982; Milgrom & Roberts, 1982). By developing a multi-theoretic framework which overcomes the weakness in existing theories, this study takes a concurrent and multi-dimensional view of the OBCs. This study finds the relationship between ownership of assets and reputation which is currently not known (Grossman & Hart, 1986). The study also utilizes concurrent stochastic games (CSG) to describe the outcome-based contracts phenomenon in PRISM and PRISM-games platform. Through stochastic games, a modeling and computational framework in the study of multi-agent dynamical systems, this thesis meets the recommendation in corporate strategy literature to mix concepts from computer science (Menz et al., 2021; Zhang et al., 2021).

1.4 BUSINESS PROBLEM STATEMENT

Given the above trends in the IT industry, the business problem at an ITS firm level is stated below:

- Business opportunity is abundant in outcome-based contracts.
- Reputation for automation assets and digital transformation capabilities are critical requirements for success in outcome-based solutions.
- Contracts should address issues like incomplete contracts and outcome uncertainty.
- Incentives to invest and protection against strategic behaviour need inclusion in contracts.

1.5 THEORETICAL BACKGROUND

The business problem demands a research study which keeps the outcome-based contracts as the central issue. The contracts are the subject matter of theories of the firms under the lens of contract tool kit (Williamson, 2002b, 2003). These theories study the strategic consequences/inefficiencies of incomplete contracts and provide remedies in the form of optimal contract structures that alleviate the impact of those consequences. The contract structures are called *governance structures*, *ownership structures* or *control structures* in the leading theories of firm behaviour – *property rights theory* and *transaction cost economics* (Grossman & Hart, 1986; Williamson, 1979). An optimal structure reduces transaction costs and induces investment incentives, both being primary purposes of contracting (Williamson, 1985). In addition, the *theory of reputation* adds dynamics to the otherwise static nature of the lens of contract tool kit (Kreps & Wilson, 1982). The study also needs to consider the technology's role in meeting the purposes and alleviating the inefficiencies (Menz et al., 2021; Williamson, 1983, 1988).

1.6 RESEARCH PROBLEM, QUESTIONS AND OBJECTIVES

This particular theoretical background converts the focal business problem into the following research problem:

How a hybrid (inter-firm) outcome-based contract as a function of service provider reputation overcomes incomplete contract due to bounded rationality, outcome uncertainty, strategic behaviour, inefficient investment and other ex-ante and ex-post contract inefficiencies.

This study used the research questions given below as the guardrail to spotlight the problem phenomenon:

RQ1. What is the relationship between ownership of assets by service provider and reputation?

RQ2. How can investment in assets be optimized at various stages of business to establish OBC execution capability as a reputation?

RQ3. How does inter-firm interaction happen and stabilize in OBC project as a function of service provider reputation?

RQ4. How do inter-firm and intra-firm interactions influence the OBC service offering as a function of service provider reputations?

The considered research objectives include:

1. To establish the relationship between ownership of assets by service provider and reputation.
2. To find out the pattern of investment optimization on assets at various stages of business to execute OBC as reputation.
3. To study the process of establishing service provider reputation through inter-firm interaction in the OBC project.
4. To study the process of establishing service provider reputations through inter-firm & intra- firm interaction in the OBC project.

1.7 RESEARCH METHODOLOGY OVERVIEW

By considering the scarce conceptual and empirical literature on the OBCs, a mixed method of study is used. A conceptual framework by synthesizing property rights theory, transaction cost economics and reputation theory was developed, and testable propositions were derived. The propositions were tested in quantitative and qualitative environments. As recommended by reputation literature (Halonen, 2002; Kreps et al., 1982a; Kreps & Wilson, 1982), repeated games–based modelling was performed. Since the OBC phenomenon involves the strategic interaction of multi-objective players in the uncertain stochastic environment, the framework of a concurrent stochastic game was used (T. Chen & Lu, 2007; Kwiatkowska et al., 2020). Functional forms of

technology assets of the players were developed to define player behaviour. PRISM-games, a reinforcement learning platform, was used for simulation and model checking. Due to non-disclosure contracts and COVID-driven work-from-home policies, the open-ended essay questions approach was used as the qualitative method. It is a popular tool to gain rich insights from unlimited text-based responses and to perform experiential assessments (Bennion et al., 2020; Chaudhary et al., 2022). Propositions were tested independently in both methods and triangulated.

1.8 POTENTIAL SIGNIFICANCE

The opportunity for the ITS sector in the OBCs is clear and present. A survey by the National Outsourcing Association (UK) projected more than 90 per cent of firms opting for the OBCs (Coward, 2016). Deloitte reported that more than 76 per cent of enterprise customers (henceforth, “the customers”) have discussed outcome-based approaches with their service providers (henceforth, “the providers”) (J. Gill et al., 2021). Gartner 2021 survey revealed the willingness of the Boards and CEOs to invest in technologies which are tied to business outcomes (Rimol, 2021). The possible renegotiation of more than 60 per cent of the existing contracts indicates potential opportunities for the OBCs (Himmelreich et al., 2021). A BCG 2021 survey indicated more than 45 per cent of purchasers prefer the OBCs. A study by IDC FutureScape predicted that enterprises preferred contracts which tie in business outcomes and leverage their technology foundations in AI, machine learning and customer data (Shirer, 2022). Gartner mentions business outcomes as the main focus for demonstrating the business value (Naegle, 2022). Investment by Recognize in 2X and AST for their OBC-based business model indicates the serious attention the model receives (Francisco, 2023). The shift to outcomes is a remedy for traditional effort-based providers which face competition from outcome-based mid-size system integrators and economic headwinds (Kovar, 2023; Masters, 2023).

The revenue potential is immense with projected global IT spending at USD 430.50 bn in 2023 with a CAGR of 8 per cent over the next 5 years (Statista, 2023b). Indian service providers are expected to capture more than 19 per cent of the global spend (Sun, 2022). The market for outcome-based software was estimated at USD 66 bn in 2020 with a growth rate of 11 per cent

(Konikoff et al., 2021). The digital transformation market was projected as USD 1.91 Tn for 2021 with a CAGR of 21 per cent for the next 8 years (Fortune_Business_Insights, 2023). The projected size of AI related opportunities is USD 2 Tn in 2030 (Statista, 2023a). In summary, the absence of a reputation for outcome-based contracts, automation assets and digital transformation capabilities for any ITS firm leads to opportunity loss.

1.9 THESIS DISPOSITION

Chapter 2 organizes a theme-based presentation on firm theories in performing economic activities by markets, contracts, and the existence of firms. This chapter covers theories that conceptualize firms as a set of principal-agent, nexus of contracts, governance structures, ownership rights and reputations along with their assumptions, prepositions, and limitations. The chapter includes game theoretic modeling of strategic phenomena. This chapter reviews extant literature on outcome-based contracts and related phenomena. This chapter ends with initial conceptual constructs related to the problem phenomenon and identifies the gaps in the literature. The methodology is presented in Chapter 3. The research focus and research problem statement are derived first including literature gaps. Next, the set of research questions and objectives to guide this study are presented. Chapter 4 presents the mathematical model development in PRISM and PRISM-games. The findings from testing of the propositions are reported. Chapter 5 reports the findings of the qualitative method based on an open-ended essay methodology. Chapter 6 integrates these findings and discusses a synthesized results summary. The presentation includes theoretical contributions, practical implications, study's limitation and future prospects are presented. Chapter 7 concludes.

2. LITERATURE REVIEW

The review of literature involves collating and assessing significant theories, theoretical or conceptual frameworks and empirical studies in a particular intellectual area (Saunders et al., 2009). The review should enable the researcher to understand how far the literature has progressed and the shortfall or gaps or scope for further improvement in the area. A good researcher should have a complete understanding of the theoretical foundations on which his work stands (Montgomery et al., 1989). To fulfil this guidance, this researcher structured the literature review by perusing both review literature and research papers in contracting literature. The researcher considered the review literature on IT outsourcing that subsumes the problem phenomenon of outcome-based contracts, similar phenomena such as performance-based contracting and related phenomena such as servitisation in the equipment services industry. In addition, this study organizes the related literature in a theme-based approach. Each theme ends with the gaps in the literature. The literature for the review is selected from google scholar searches by using the keywords derived from business problems – outcome-based contracts, incomplete contracts, outcome uncertainty, incentives to invest and strategic behaviour in contracts. The selection includes literature that is critical in developing the theory and on whose shoulders the other researchers stand. The literature is expanded with relevant papers while developing the logic and argument for deriving the propositions in Section 2.6. The review offers a detailed examination of theories listed under the *purpose of contracting* (Williamson, 1985), and their strengths and weaknesses vis-à-vis the requirements of the problem phenomenon. The reviews strengthened the understanding of their relevance and limitations in explaining the OBC phenomenon (Aghion & Holden, 2011; Demsetz, 1998; Foss & Foss, 2015; Hart, 1989, 2017; Maskin & Tirole, 1999a; Williamson, 1988). Section 2.6 presents the reasons behind the choice of theories chosen to build the conceptual framework. The framework is used to analyse the inefficiencies of the OBCs and the capabilities of the chosen technologies which can alleviate those inefficiencies. The propositions explain how the interaction of technology, ownership and reputations implement investment incentives and safeguards in a successful outcome-based contract.

2.1 THEME I: IT OUTSOURCING & OUTCOME-BASED CONTRACTS

This section reviews the research trends in outsourcing, performance-based contracts, and outcome-based contracts.

2.1.1 IT Outsourcing

IT outsourcing is a process of contracting out a firm's IT and related operations to an external provider specialized in IT skills. The goal is to meet specific contract objectives (Dahlberg & Nyrhinen, 2006). Lacity, Khan, et al. (2017) provides empirical literature review for 25 years by summarising the influencing factors behind outsourcing contract decisions on the customer side and factors which determine the contract outcomes. The two figures below show the results.

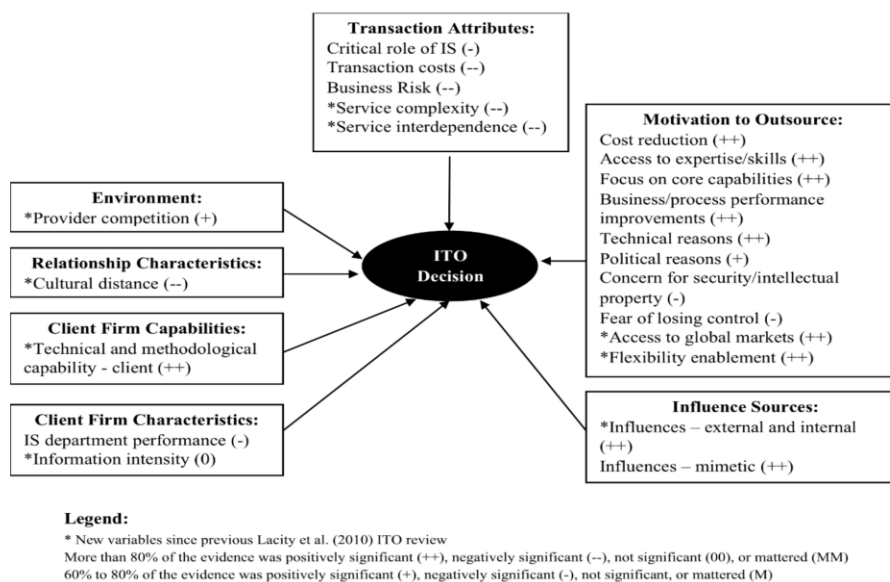


Fig. 2.1: Variables determining ITO decisions (Lacity, Khan, et al., 2017)

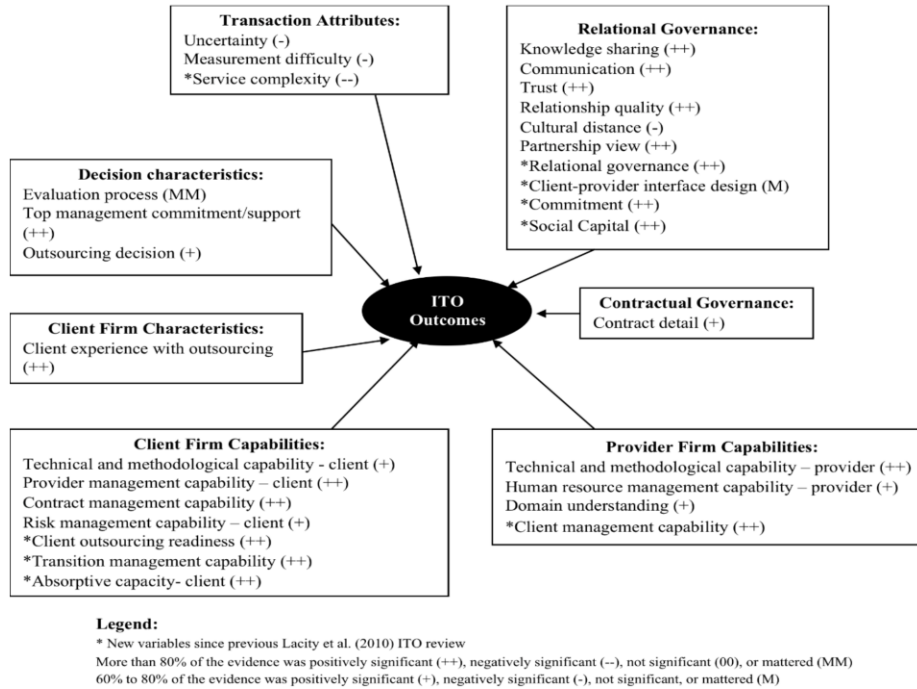


Fig. 2.2 Variables determining ITO outcomes (Lacity, Khan, et al., 2017)

The major customer objectives are to strengthen the focus on their essential business activities while reducing the cost of IT by accessing the core skills of a service provider. The current focus of the ITO researchers is on offshoring experiences and new phenomena such as multi-sourcing, open-sourcing and crowd-sourcing (Lacity, Khan, et al., 2017). The ITO research is dominated by the use of the frameworks in theory of institutional isomorphism and transaction cost economics. A main path analysis identified transaction cost economics as the dominant framework followed by agency theory, incomplete contracts theory and resource-based theory driving the literature (Liang et al., 2016). Neither review highlight outcome-based contracts.

2.1.2 Performance-based Contracts and Servitisation

A review of the operations management literature explicated performance specification and payment mechanism as the main concepts in performance-based contracts (PBC) (Selviaridis & Wynstra, 2015). The performance of the product is specified as “outcome” and “outputs” which

are defined as monetary values and uptime respectively derived by the customer. The payment mechanism is partially or fully linked to performance. Rolls-Royce, Caterpillar, and Hitachi bill customers for equipment utilization hours (Visnjic et al., 2017). Logistics, infrastructure management and health care are other industries which operate outcome-based services.

A systematic literature review in PBC research listed the following major frameworks (Selviaridis & Wynstra, 2015):

- Agency theory
- Transaction cost economics
- Management Control Theory

The above review recommended the use of a multi-theoretical lens by combining TCE with Property Rights Theory (Hart & Moore, 1990). The combination, which focuses on transaction costs and residual control rights, is suitable for studying incentives and associated risks in the PBCs.

2.1.3 Outcome-based contracts

The OBC phenomenon is defined as a contract mechanism which terms provider payments as a function of outcomes delivered by continual use of the provider's solution in the production environment of the customer (Hou & Neely, 2018; Neely, 2011; Ng et al., 2013).

As shown in Fig. 2.3, the OBCs in IT services are categorized as: (i) *IT outcome* which reduce IT costs by efficient availability of IT devices; and (ii) *business outcome* which commits on revenues or costs by using the provider's solution (Cao et al., 2012). The first is called an *aOBC* (*availability-based*) or "*managed services contract (MSC)*" and the second as *eOBC* (*economic-based*) or simply as *OBC* (Böhm et al., 2016; Kumbakara, 2008). The contract between Bharti Airtel and IBM to pay based on the use of IT infrastructure is cited as the earliest case in OBC literature (Ghosh, 2008).

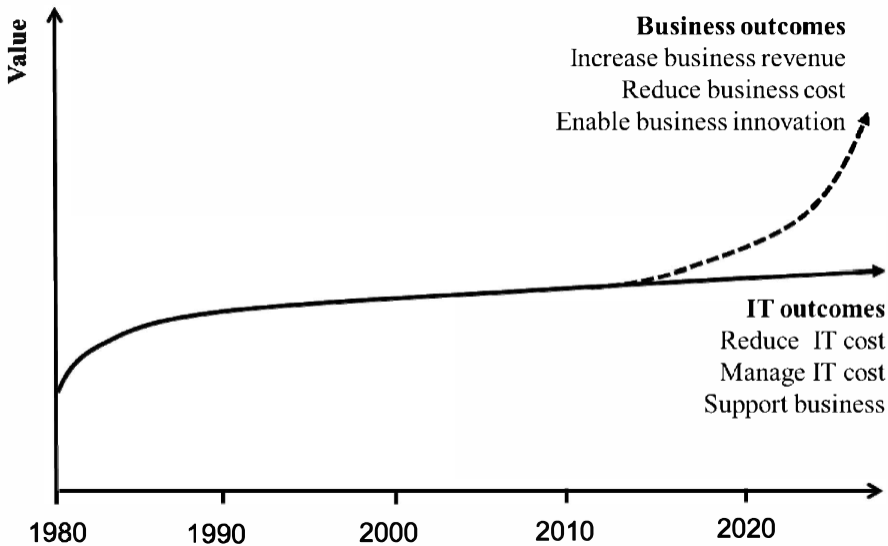


Fig. 2.3. Transition of contracts from IT outcome to business outcome (Cao et al., 2012)

2.1.4 Treatment of technology in the theory of firms

Transactions (selling or buying a product or service) are organized either in markets or firms. The cost of organizing a transaction whose detail cannot be stated ex-ante (e.g. What labour is expected to do?) may be indeterminate in markets (Coase, 1937). Firms exist to organize such indeterminate transactions (by making a labour an employee) at less cost. Technological changes improve managerial capability which reduces organizing costs within a larger firm. Technological advancements in information sharing reduce the cost of organizing in markets. What determines firm boundaries are technological non-separabilities (Alchian & Demsetz, 1972). Neoclassical economic theory treats a firm as an Input-Output transformation device with its technology as the limiting factor (Hart, 1995; Hart & Holmstrom, 2010; Madhok, 2002). The cost of transactions, size and boundary of firms, and efficacy of governance structures are determined by information and technology (Coase, 1937; Rosenkranz & Schmitz, 2004; Williamson, 1988). High complementary assets under common ownership assure large technological returns to scale

(Joskow, 1988). Less complementary or standard technology assets with no or easy modification can be organized with any partner (Hart, 1995).

2.1.5 Research Gaps in Theme I

The following is the list of research gaps identified in this theme:

- No single theory sufficiently explain today's outsourcing phenomenon which are dominated by digital technologies and hence new ITO theory is needed (Lacity et al., 2011; Menz et al., 2021).
- A faithful appropriation of TCE should be done in ITO research (Lacity & Khan, 2016).
- The benefit of combining multiple theories in the lens of contract toolset to study OBC phenomenon is not known (Selviaridis & Wynstra, 2015).
- The effect of variables such as monitoring cost, ease of measurement, risk aversion, and conflict of interest in the OBC phenomenon is not known (Ng et al., 2009).
- The effect of reputations from ownership of automation and digital transformation assets in OBC phenomenon is not known.

2.2 THEME II: PROPERTY RIGHTS ECONOMICS-ACD GENRE, INCOMPLETE CONTRACTS, TRANSACTION COST ECONOMICS

A contract is an adaptable framework which provides a rough indication of working relations, and guidance when in doubt and is used for a final plea when the relations sour (Llewellyn, 1931). This highly elastic framework supports cooperative exchanges in the presence of contractual disturbances (Williamson, 2010). Theories of the firms provide analytical tools to determine when economic organizations such as firms, markets or any other form become necessary for exchange relations (Coase, 1937). These theories explain factors which influence the behaviour, performance, and boundaries of organizations. Cooperation is achieved from contractual agreements of different types both within and across organizations (Demsetz, 1998).

The following figure shows *Cognitive Map of Contract* which was used to select firm theories to guide the characterization of OBC transactions between parties (Williamson, 1985).

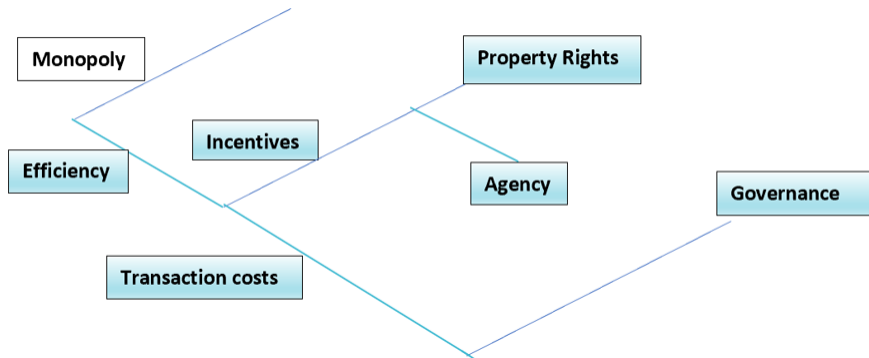


Fig. 2.4. Cognitive Map of Contracts (Williamson, 1985)

This study used the theories under the efficiency branch of the above map which focuses analytical action on: (i) incentive alignment between parties that induces truthful investments; and (ii) governance structure that minimizes transaction costs of the parties.

2.2.1 Property Rights Economics-ACD Genre

The idea of property rights was prevalent for a long period. Coase (1960) emphasized the allocative efficiency of property rights in increasing production value. The idea was linked to law, social norms and customs (Alchian, 1965; Coase, 1960; Demsetz, 1967). This study wants to distinguish this literature on property rights in this section as ACD genre by using the first characters of the three authors. Property rights is defined as the authority assigned to the owner to perform certain actions over his asset (production factor) which are circumscribed, exclusive, and regulated for a particular use (Alchian, 1965; Coase, 1960). Property rights offer protection against the infringement of that asset from use by non-owners. Property rights prohibit the owner from affecting others' assets using his assets. Such negative *externalities*, also called *violation of others'*

property rights, cover only the physical attributes affected party's assets. The owner can retain sub-rights of an asset and contract away the rest (ex. Renting) to others.

Transaction costs arise in a market-based pricing system as the parties undertake costly actions to identify the market and agents, anticipate eventualities and corresponding responses, negotiate and draft a contract, monitor its execution and take legal recourse for enforcement (Coase, 1960; Hart & Holmstrom, 1986). Such transaction costs induce appropriate reallocation of property rights which leads to a net social benefit. The optimal system of property rights, i.e., market or firm, is the one which increases the asset value and is enforceable by a legal system. Within a firm, the bargaining for allocation takes place under an administrative system such as owners/managers.

The property rights of owners (hereafter “ownership rights”) are categorised as (Alchian, 1965):

- Joint ownership if shared among multiple owners such as partnerships or corporations. It allows the sale or transfer of ownership.
- Public ownership if everyone has a share, resale is not allowed, and ownership is compulsory.

Each ownership arrangement induces different consequences on the use of an asset and the behaviour of non-owners. Any transaction in an economic system contains an exchange of both physical assets and expected value from the asset (Demsetz, 1967). The expected value depends upon the social and legal setting in which the rights are exchanged. An externality is positive if it is beneficial or negative if it is harmful. An externality is created when the cost of enforcing the effect of the particular use within the interacting persons is too high or not worth it. Property rights provides the owner the right to benefit if it causes positive externalities that benefit society such as new inventions (good type). It costs the owner and others if property rights lead to negative externalities that harm a society such as pollution (bad type). Reallocation of property rights leads to *internalization* when the effect of the externality is borne by the interacting persons. Such incentives are implemented in the form of the *right to sale* bundled with the ownership rights. Every innovation or technology induced by the preferences of society unfolds new property rights

which can cope with the corresponding externality. The cost of internalization is high in public ownership because of overexploitation of the asset with no cost to the exploiter. The cost of curtailing, policing, and negotiating the rights for optimal behaviour will be prohibitive in public ownership. Private ownership internalizes the externalities (minus the spillover) and concentrates the value ($=\text{income} - \text{cost}$) on the owner. It imposes a lower cost to negotiate optimal behaviour that maximizes the net present value from the asset ownership rights. The cost of internalization in multi-owner private ownership increases in the number of owners. Corporations with large externalities are owned by large numbers of shareholders. In such corporations, property rights in the form of decision authority are allocated to the management to avoid the cost of negotiating with all shareholders for every decision. This type of allocation separates *control from ownership* (Jensen & Meckling, 1976).

Another view emphasized monitoring and measuring individual contributions in team production in the context of agency and shirking (Alchian & Demsetz, 1972). Allocating residual rights over the net profit to the monitor (management) incentivizes efficient utilization of resources, reduces shirking and improves information symmetry (Alchian & Demsetz, 1972). Thus, the pay of the management (residual-claimant) is correlated to the residual value of the firm. The management is the common party to all contracts in an organization. They have the right to negotiate, renegotiate or sell the residual-claimant status to any party. Since the residual claimant cannot claim the property rights of human wealth, the claim is limited to the residual income from resaleable physical assets.

Limitations of PRE-ACD Genre (Foss & Foss, 2015)

- Theory is non-mathematical.
- Focus is limited to the cost and efficiency consequences of different systems of ownership.
- Dependency on legal and other enforcement institutions.
- Focus is limited to choices over the assets and wealth derived.
- Coasian question on the economic function of asset ownership is left unresolved.
- Relationship between ownership and property rights unaddressed.

2.2.2 Incomplete Contracts

A contract is called complete if all the realizable events/states in a contract execution (ex-post) and provisions for ad hoc responses are identified at the pre-contract stage (ex-ante) with no renegotiation (Salanie, 2005). Parties' *commitment* to a particular set depends upon the contract law, relevance for reputation, outside (next best) value of the asset, *bond*, and penalties for breach. Renegotiation of the contract and replacement with the new contract without penalty takes place if all parties agree. *Full commitment* is feasible only if the contract is complete. Hence, the longer the length of the contract, the harder to predict the future states(contingencies) and the lesser the completeness of the contract (Coase, 1937). So, complete contracts with all conceivable contingencies are not realistic. The rationality of agents is bounded by their cognitive and computational skills (Williamson, 1999). This bounded rationality renders the cost of listing all contingencies in a contract prohibitive. It is also rational to let the states unfold rather than describing exhaustive eventualities (Hart & Holmstrom, 1986). Indescribable states, observable but non-verifiable (by courts) and noncontractible actions such as investment in human capital led to incomplete contracts. Hence, incomplete contracts distort relationship-specific investments and determine relative efficiencies of various organization forms. The internal organization is most efficient in settling disputes due to incomplete contracts (Klein et al., 1978; Williamson, 1985). Incomplete contracts provide scope for strategic and non-strategic uncertainties and mitigating them is the main objective of theories in cognitive map and lens of contract as explained from next section.

2.2.3 Transaction Cost Economics

A transaction defines the man-to-man relationship at the atomic level by linking law, ethics and economics (Commons, 1932). The transaction represents conflicting interests, mutual dependence, and security of expectation on its orderly future repetitions. A going concern (hereafter “the firm”) is analogous to physical mechanisms (Coase, 1937). The firm is represented as a joint expectation of the collection of interdependent transactions of bargaining, managerial and rationing nature (Coase, 1937; Hart, 1989). Transactions transfer ownership and are governed by rules. As friction

in physical mechanisms, each transaction has a cost for thinking, planning and contracting to run the economic system (Coase, 1937; Hart, 1989, 2017). The primary structures of organizing transactions in Transaction cost economics (hereafter “the TCE”) are market-based (“buy”) and firm-based (“make”) (Williamson, 1971). The market is governed by price mechanism and the firm is governed by managerial coordination (Coase, 1937). A firm reduces transaction costs of production, price discovery, and long-term incomplete contract renegotiation compared to that in the market. The allocation of factors is decided by the administration in a firm in contrast to by price in a market. The firm supersedes the market when transacting within the firm costs are lower. Thus, the firm is a response to the failure of the price mechanism (Hart & Holmstrom, 1986). A transaction is characterized by the following concepts (Williamson, 1971, 1979, 2009): (i) *asset specificity*, which indicates greater value an asset in a specific transaction with imperfect transferability to outside (also called *sunk*); (ii) *transaction frequency* which is categorized as one-time, occasional, and recurrent, and determines transaction costs for haggling, learning, reputation effect and setup costs; (iii) *uncertainty* which includes strategic (behavioural) concepts such *moral hazard*, *adverse selection*, and haggling (exploitation) and non-strategic factors such as market demand, economic changes, and government regulations. Moral hazard is due to hidden (unobservable) actions of agents such as *shirking*. Adverse selection emerges due to hidden pre-contractual information/knowledge. *Governance* is the core of the TCE which is defined as a workable arrangement that infuses order, mitigates conflict and realizes mutual gains in a transaction (Williamson, 1998, 2003, 2005). The institutional frameworks offer a *governance structure* within which transaction integrity is decided through negotiation, attenuation of strategic behaviour and execution. The governance structure is also called *institutions of governance* and *feasible mode of organization*. The following are various types of governance structures: (i) *market* contracts for spontaneous transactions concerning routine, trade, non-specific, identity-less, generic and standardized goods or investments; (ii) *hybrid* contracts (also called *relational*, *inter-firm*) for intentional transactions with bilaterally dependent investments of asset specificity which need continuity of relation for safeguards against uncertainties; (iii) *hierarchy* (also called *firms*, *internal organization*, *internalization*, *integration*) for transactions of specialized and imperfectly transferable assets which exceed the adaptive limits of other structures. The predictions of the TCE are based on a discriminating alignment hypothesis. The hypothesis aligns transactions to a comparably efficacious governance structure on costs and competencies that lead to economized

ex-post transaction costs (Williamson, 1991c, 1998). The chosen structure should instill good order to mitigate conflicts and contract hazards (inequitable adverse impacts) (Williamson, 2005, 2012). The structure should consciously facilitate coordinated adaptations to unforeseen disturbances and the realization of mutual gains ex-post. There is a tolerance level of attributes contributing to transaction costs beyond which market and hybrid fail. Such transactions must be brought under hierarchy, a process called *internalization* (Williamson, 1971). A hybrid structure with no ex-ante surplus sharing rule remains optimal if parties benefit at joint profit-maximizing quantity with intermittent renegotiation until no party is believed to have above-normal returns (Williamson, 1971). In addition, appropriable quasi-rents from an asset, i.e. the difference in its value between inside and outside a contract, are used as *holdup* or *threat points* (Klein et al., 1978). This theory predicts that anticipation of such strategic behaviour leads to integration as an eventual safeguard. This prediction was tested empirically with many with favourable evidence (B. S. Tadelis, 2016). Fixed price and cost-plus contracts are introduced as an extension of TCE concepts. Fixed is preferred if the design is highly complete and a cost-plus if the design is lowly complete. Renegotiation in an asset-specific situation consequent to a design failure leads to surplus dissipation (B. S. Tadelis, 2016). Integration is a terminal stage from the cost-plus option if the design is more complex or haggling is more frequent.

The constraining assumptions are agent's selfishness and limited rationality (Williamson, 1979). Contract incompleteness is inevitable since boundedly rational agents cannot comprehend all eventualities or states of a contract (Williamson, 2005). In addition, TCE also assumes private ordering by immediate parties for good order and satisfactory dispute resolutions in continuous bargaining (Williamson, 1985, 1991c, 2002a, 2005).

The main propositions of transaction cost economics are: (i) governance structures are determined by their relative efficiencies on competencies and costs in dealing with ex-post transaction costs from haggling and opportunism (Williamson, 1991a); (ii) The appropriate governance structure minimises ex-post transaction cost; (iii) Opportunism results in the appropriation of quasi-rents by uninvesting party (Williamson, 1999); (iv) Transactions require simultaneous decisions on price,

governance structure and production technology as some structures become infeasible under a particular technology (Williamson, 1983).

Limitations of Transaction Cost Economics

- Lack of operational propositions and formalization which are works in progress (Baumol, 1986; Williamson, 2012).
- Over emphasis on cost efficiency and underestimation of value creation such as learning, and collaboration (Menz et al., 2021).
- Hybrid governance structures with porous boundaries in practice fail the TCE predictions (Menz et al., 2021).
- New generations of contracts of crowdsourcing, platforms, double-sided markets, and artificial intelligence are works in progress (Cuypers et al., 2021).
- The consequences due to the self-interest of the acquired party are not covered (Grossman & Hart, 1986)
- The definition of integration is ambiguous in assessing its benefits and costs (Grossman & Hart, 1986). For e.g., there is no differentiation between franchisee-franchiser and central office-direct branches, i.e., the direction of integration.
- Transaction costs under hierarchy will be least is less convincing. How the nature of transactions differs in hierarchy needs explanation (Hart, 1989; Kreps, 1990b).
- Costs of integration are not explained in a unified manner other than as “bureaucracy costs” (Hart, 1988, 1989).
- ex-ante inefficiencies are ignored by assuming symmetric information, and competitive contracting which remove excess surplus (Grossman & Hart, 1986; Hart, 2017; Hart & Holmstrom, 1986). It leaves out ex-ante incentives for efficient investment (Hart, 1989).
- Does not differentiate between contractible and non-contractible investments (Hart, 2017).
- More emphasis on authority relations over the human capital (Hart, 1989, 2017).

2.2.4 Research Gaps in Theme II

The following is the list of research gaps:

- Ex ante inefficiencies are not known to be addressed (Hart, 1989). Ex-ante underinvestment by parties foreseeing ex-post strategic behaviour is not known to be addressed.
- Development of Core theory by anchoring economizing as strategy is required (Williamson, 1991c).
- Theory is still fragmented, an integrated realistic theory of the firm which integrates the best concepts across all theories is needed (Hart, 1989).

2.3 THEME III: AGENCY THEORY, PROPERTY RIGHTS ECONOMICS-GHM GENRE

2.3.1 Agency Theory

The firm contains a collection of production plans which are economically feasible (Hart & Holmstrom, 1986). The firm runs under a pay-off sharing principal-agent contract. Return to specialization is the source of agency (Hart & Holmstrom, 1986). The agent (management or specialist) is a decision-maker who takes actions which benefit both the agent and principal. The principal (shareholders) sets the payoff rule for the agent contingent on the observed state ex-post while monitoring his actions through indirect means (Arrow, 1984). The outcome of a system of agents is an observable random choice affected by the actions of all the agents. Agents inflict agency costs due to *asymmetric information* among agents, uncertainty in predicting the ex-post state and exogenous factors. The sources of *inefficiencies* (contract hazards) are moral hazard, adverse selection, *residual loss* due to divergence of interest, *bonding*, and *monitoring*. These channels let the productive capacity of a system of agents (the firm) get eroded (Arrow, 1984; Jensen & Meckling, 1976; Salanie, 2005; Shavell, 1979). Low monitoring increases opportunism (Williamson, 1979). Asymmetric information generates *informational rent* wherein the customer

is unaware of the production cost (producer's *private information*) and the producer is unaware of the value of the good (customer's *private information*). Parties manipulate or take advantage of their private information to the best of their interest. The higher the effort of the agents, the larger the probability of exceeding the contracted output. Conversely, higher output does not need higher effort always (Hart & Holmstrom, 1986). Since action is a disutility for the agent, its truthfulness depends upon his risk preference and action observability. In adverse selection, the agent (*informed party*) knows something which the principal does not, ex. Productive capacity of assets. The inefficiency arises when the principal does not know whether agents use all the information for the benefit of the principal. Intentionally hiding information is otherwise called "*strategic misrepresentation*." The *uninformed party* (principal) moves first in adverse selection premises. *Screening* and *mechanism design* such as auctions reveal the truth and narrow the informational gap. The informed party moves first in the *signaling model*. These approaches help to *separate* or *bunch (pool)* the type of agents to *hedge* against the overexposure risk to a particular type. They maximize the payoff by spreading the risk over the contracts that suit each type. It is also called *personalization* and *discrimination* (Perloff, 2014). *Perfect discrimination* is a case of *first best* which *perfectly matches* the contract terms and risk preferences with information rent fully removed. Monitoring enables the principal to access more information than what is revealed by the observable realized state ex-post. Additional information includes the role of exogenous factors in the realized state. The contract types under agency theory are either behaviour-based (inputs or efforts) or output-based (Eisenhardt, 1985). Task programmability, input and output measurability, cost of, risk level, contract length and outcome determine the type of contracts. An optimal contract scheme prevents the divergence of the agent from the interest and welfare of the principal. The scheme is constrained by the agent's incentive for truthful effort and outside value. A legalistic view formulates a firm as a *nexus of contracts* signed with capital, material and labour suppliers (Jensen & Meckling, 1976; Menz et al., 2021). In this view, each firm behaves like a market.

The main assumptions of the agency theory are: (i) individual agents are risk averse, self-interested, and boundedly rational; (ii) decisions are driven by information and measurement; and (iii) contracts are complete.

Limitations of Agency Theory

- Theory assumes a complete contingent contract which is not possible in the setting of outcome uncertainty and bounded rationality (Demsetz, 1998).
- A large set of possible states of a contract renders contingent contract expensive and pre-assigning maximizing effort choice to the agent is not feasible (Hart & Moore, 1999).
- Agents are assumed to be unboundedly rational (non-cooperative), not adapted to cooperative structure (Eisenhardt, 1989a) and court ordering is efficient.
- Lack of predictive power to determine optimal contract structure by not defining the structuring of organizations and their boundaries (Hart, 1989).
- Lack of dynamic formulations and reputational effects in modelling (Hart & Holmstrom, 1986)
- Structurally not suitable as theory assumes asymmetric risk preferences (Eisenhardt, 1989a). An OBC involves two autonomous firms with similar risk preferences (Essig et al., 2016).
- Incentive alignment is set at ex-ante and no emphasis on ex-post alignment. OBC requires continuous ex-post alignment as the future evolves.

2.3.2 Property Rights Economics-GHM Genre

This new property rights theory (hereafter, “the PRT”) explains the role of ownership in incentives to invest in assets (Grossman & Hart, 1986; Hart & Moore, 1988). Here, a firm contains rivalrous non-human assets. The owner of the firm is entrusted with the residual rights of these assets. The PRT is alternatively called the *PRE-GHM* genre by using the first characters of the aforementioned three authors. This theory is a 2-stage (ex-ante relationship-specific investment, ex-post production decisions and surplus sharing) game-theoretic formulation (Foss & Foss, 2015; Hart, 1995; Hart & Moore, 1988). The theory builds its arguments on the strategic behaviour of contracting parties based on who owns the assets: (i) how the gain of ownership incentivizes truthful investment; (ii) how the loss of ownership distorts the investment decision; (iii) how the ownership is leveraged at states (contingencies) for which the asset is not contracted (residual

rights); and how these factors determine optimal ownership structure. The authority and bargaining power offered by the residual rights of control ex-post induces opportunistic behaviour ex-ante. A transaction is the transfer of residual rights (also called *general rights*) of an asset to the buyer. The new owner can use the assets for a higher utility in situations that are left incomplete in the contract. The use should have no conflict with the contracted away specific rights. Rights of ownership and control are ambiguously the same. In shareholder-owned corporations, control is delegated to the management. The owner cannot transfer the rights if an asset is pledged to a bank. Residual rights, if inefficiently allocated, can distort the incentives of parties and harm the outcome. Thus, transfer of ownership as integration offers benefits but also costs corresponding to harms such as underinvestment by the party who loses the ownership. However, the observability of variables and the cost of writing contracts remain the same post integration.

The following variables describe a model in this theory (Grossman & Hart, 1986). Two independent asset owners make joint production decisions which are ex-ante non-describable and non-contractible. Hence, the respective owners control the residual rights. The surplus sharing and ex-post actions are contractible by *re-negotiation* contingent on the realized state. The theory assumes that the correlation between investment, production and surplus variables is common knowledge among the parties. Since information is symmetric ex-post, efficient allocation of ownership and surplus sharing can be executed. The ex-ante planned surplus division is a function of ex-ante ownership distribution. The ex-post surplus distribution is Nash bargaining value of 50:50. The surplus depends upon the truthfulness of production decisions by the parties and the expected private benefit accruing to each if a trade is made. The non-verifiable, concurrent and noncooperative ex-ante investment decisions distort the production decisions depending upon the chosen ownership structure ex-ante. The party which has ownership will overinvest and the non-owner will underinvest. Hence, the optimal allocation of ownership must consider asset characteristics and must be determined ex-ante to minimize the distorted investment.

The following marginal performance characteristics determine the asset type based on its use outside a contract (Hart, 1995): (i) *independent* asset has zero marginal loss; (ii) *complementary* asset has positive marginal gain; and (iii) *strictly complementary* has zero marginal gain. The

optimal ownership structure is the one which induces efficient ex-ante investment and safeguards the ex-post production decisions without opportunism such that the surplus is close to the first best.

The main propositions are: (i) If either investment, production or the surplus is contractible ex-ante, then the first best joint surplus is realizable irrespective of ownership structure (Grossman & Hart, 1986); (ii) First-best is realizable if investment and production variables are not contractible ex-ante; (iii) Under non-integration, the parties' ex-ante actions will form a non-cooperative equilibrium by anticipating ex-post renegotiation (opportunism). The functional form of cost of action is convex and of payoff is concave in its action. The surplus will be less than the first best in this model due to underinvestment (non-cooperative equilibrium) relative to the first best. Parties attach a weight of 0.5 on non-cooperative production decisions which will be ex-post inefficient. (iv) The first best is realizable if the outcome does not depend upon ex-ante investments; (v) non-integration (analogues to market contracts in the TCE) is optimal if economically independent assets are allocated to individual owners (Hart & Moore, 1990); (vi) *common ownership* (analogues to *hierarchy* in the TCE) of allocating residual control rights to one owner is optimal if non-contractible decisions have little effect on the surplus. Common ownership is also called *unified ownership*, *internalization*, and *integration*. Common ownership is optimal if assets are strictly complementary. If not integrated, the interested party with an important investment must overinvest relative to the first best to overcome the underinvestment by the other party. Fig. 2.5 pictorially presents the effect of investments in various ownership options; (vii) A *joint ownership* with veto rights leads to assets of no party because each owner may hold up the other. Hence, joint ownership of complementary assets is not optimal; (viii) The ownership type is dynamic and changes in the transaction environment may shift the equilibrium to different ownership of better efficiency (Kreps, 1990b); (ix) Ex-post haggling results in deadweight loss such as value loss, cost increase, aggrievement and shading until a satisfactory reallocation of ownership (Hart, 2007; Hart & Moore, 2007). A flexible contract has a tendency for shading in a good state of nature (Fehr et al., 2011). Hence a fixed/rigid contract is preferred in a good state, and a flexible is preferred in a bad state of nature.

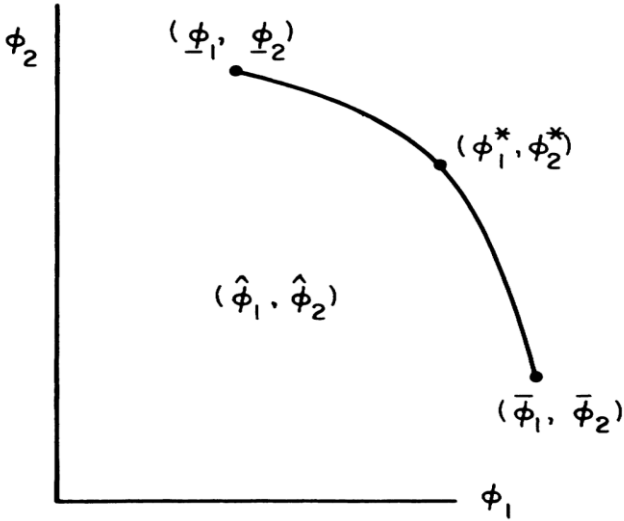


Fig. 2.5. Outcomes vs. Forms of Ownership

The assumptions of PRE-GHM are: (i) Residual rights are definable, enforceable, and non-contestable (Hart & Moore, 1999); (ii) Legal and other institutional support exists to protect the ownership; (iii) Agents are boundedly rational, particularly in assessing the depth of the breach and giving contractual instructions to the courts (Hart, 1990); and (iv) contracts are incomplete.

Limitations of Property Rights Economics – GHM genre

- Maskin and Tirole (1999) countered the argument that bounded rationality and indescribability cause incomplete contracts. These causes can be overcome through welfare-neutral contracts if parties agree not to renegotiate ex-post.
- Obscures the ex-post governance of contract inefficiencies such as contract maladaptation, lack of competitive information (lock-in effect) and strategic behaviour (Williamson, 2002b, 2003).
- Lack of empirical testability of propositions particularly the direction of integration – whether firm A should merge with firm B or vice versa (Williamson, 2002b, 2003).
- Emphasis is on incomplete information and marginal effect due to ownership changes rather than on transaction characteristics (Williamson, 2003).

- The theory does not preclude the non-residual contractor from insisting on a contract clause in deterring the use of the residual rights against his interest, thereby reducing the strategic advantage of an owner of residual rights (Demsetz, 1998).

2.3.3 Research Gaps in Theme III

The following is the list of research gaps identified during the literature review:

- Relevance of ownership of assets on reputation is not known.
- The behaviour of parties under repeated relationships is not known to be addressed by the 2-stage game format of PRE-II (Garvey, 1995; Halonen, 2002).
- The effect of interaction between ex-post rents, coordination, information leakage by the informed party and belief of the other party in renegotiation is not known.
- Variations in management techniques, contractual forms, correspondence between the structures of firm ownership and asset ownership structure are not fully explained (Demsetz, 1998).

2.4 THEME IV: REPUTATIONS, GAME THEORY & REPEATED GAMES

2.4.1 Theory of Reputation

Reputation is defined as the behavioural consistency between dealing with contracted and uncontracted contingencies in a long-term relationship (Alchian & Demsetz, 1972; Klein et al., 1978). A pattern of promised behaviour is a productive asset for a firm in attracting future customers with a higher valuation for that behaviour. The premium thus earned is the return on the reputation. The loss of reputation by a behaviour inconsistent lead to customer dissatisfaction and erosion of reputational capital. Reputation acts as a bonding instrument and protects contracting parties against opportunism. Reputational effect matters in markets with frequent transactions and unforeseen contingencies, fairness, disincentive to hold up, and low cost to distinguish between

bad and promised behaviour (Holmstrom & Tirole, 1987; Joskow, 1984; Williamson, 2002a, 2008). In these markets, the future cost of lost reputation is more than the rent from bad behaviour today (Williamson, 1991c). The real test of reputation is when an uncontracted contingency becomes consequential for a party and the corresponding cost is greater than the discounted present relationship value. The affected party may behave strategically in such situations. The likelihood of strategic behaviour will be minimal in a market where reputation effects matter (Williamson, 2008). The reputation effects will tolerate a higher level of asset specificity. Intra-firm reputation will lower the opportunism among managers and hence the cost of hierarchy. Credible commitments and consistently good experience lead to the generation of reputation effects if dispute resolution is assured through private ordering (Williamson, 2009, 2010). On the contrary, fraud which increases the current profit but reduces future income is likely to be prevalent in a mobile society (Coase, 1988b). It costs to find and avoid fraud by suppliers in such markets.

In an organization, the contracted decisions need to follow the contract terms. The source of reputation is only the residual control or *decision rights* (Holmstrom & Tirole, 1987). Therefore, it is prudent to allocate residual decision rights to parties who intend to invest in reputation. This ensures a fair deal when facing unanticipated events. The question is if managers focus too much on reputation, will that not affect their authority? The corporate culture operates as a principle inculcated through a long-lived player's history (inter-temporal life) in synchronizing the employee behaviour to unanticipated contingencies (Kreps, 1990b, 1996b; Williamson, 1999). Authority comes from reputation rather than from assets, and reputation determines firm behaviour in completing an incomplete contract (Kreps, 1990a). A culture of consistent behaviour sets up reputational expectations among the firm's transacting partners. Reputation is a substitute for physical assets particularly where physical assets are hard to find like service sectors. The firm holds only reputational capital when facing uncontracted contingencies. Relational contracts become self-enforceable if both parties have sufficient reputations (Gibbons, 2005). Such reputational concerns set up incentives for the party at the upstream even though the asset is owned by a downstream party (Baker et al., 2002).

The assumptions of the theory of reputation are: (i) Actions are observable and contractible; (ii) Faithfulness of recent transactions is known; and (iii) Parties have common knowledge of ex-ante payoffs (Kreps & Wilson, 1982).

Limitations of the Theory of Reputation

- Reputation being the only means, firms are not more than a label (Hart, 1988).
- The relationship between reputation and ownership of assets is not explained (Grossman & Hart, 1986).
- While the behaviour of reputation to the agreed states is understood, the behaviour of unanticipated states is not clear (Hart & Holmstrom, 1986).
- Trust is an elusive and illusive concept and efficacy is problematic (Williamson, 2003, 2008).

2.4.2 Game Theory

A contract is a strategic interaction between parties which is modelled as a non-cooperative game with asymmetric information (Salanie, 2005). Parties revise their beliefs about the other party's behaviour through Bayesian updates and optimize their decisions as perfect Bayesian equilibria. A Stackelberg game represents the principal-agent relationship with the principal (leader) moving first with a contract proposal to the agent (follower) who either accepts or rejects.

The application of the strategy of games to analyze the rational behaviour of economic agents in an *exchange phenomenon* is called *game theory* (Von Neumann & Morgenstern, 1945). It is a study of how much utility or profit an agent can get by reacting to the preferences of other agents. The equilibrium is the simultaneous solution of maximization problems of all the agents involved in the exchange. Every phenomenon contains a state of absolute equilibrium which determines the payoff of each participant. Imputation is used to determine how much each rational party obtains and how the total outcome can be distributed among participants. The total outcome is zero (zero-

sum games) or a positive variable (positive-sum games). A 3-person game allows 2-persons to form a cooperative *coalition* to compete against the third thereby converting into a 2-player game. The game is solved by determining one outcome which dominates all other outcomes. Participants will relinquish **b** for **a** if **a** dominates **b**. **a** will be called *superior* when it dominates all other outcomes and is dominated by none. (ii) Dominations are disjoint, i.e., when **a** dominates **b**, **b** dominates **c**, and no conclusions can be drawn between **a** and **c**.

Nash Equilibrium, Nash Bargaining: If n-tuple of (pure strategy, payoff) pairs of each player plotted in a strategy-product space, then the dominant tuple counters all strategies of other players by providing a maximum expected payoff (Nash, 1950). The point and its set of countering points form a convex relationship. The dominant tuple which counters itself is a point contained in its image in Kakutan's fixed point theorem and is called an *equilibrium point*. Mixed strategies are probabilistically distributed pure strategies resulting in probability-weighted expectation payoff. A bargaining problem to share the mutual benefit from voluntary exchange can be formulated as a 2-player positive sum game. It is assumed that both agents are rational with equal bargaining skills and have the same intention of maximizing the payoff (utility). That is, they will bargain until they receive an equal share of the total surplus. Through geometric analysis, it is shown that Nash Bargaining solution = 1/2 of the total surplus (Nash, 1950).

Non-cooperative Games: In this type of finite games, players are independent and non-cooperative (non-collaborative and non-communicative) (Nash, 1951). It is shown that the solution is a set of equilibrium points of opposing best responses. There will be one equilibrium point and one symmetric equilibrium point minimum. Not all non-coop games have a solution. A game is *solvable* if the solution, i.e. equilibrium point(s), satisfies the interchangeability (symmetry) condition. The set will not have any dominated strategy. The corresponding best response of a player is called his equilibrium strategy. Strong solutions will have characteristics like saddle points (minimax = maximin) in pure strategies. The payoff for each set of strategies (pair of best responses) varies in a bilinear fashion (Nash, 1953).

Incomplete Information Games and Bayesian Players

A decision environment is called Bayesian if each player is uncertain about the game state (business environment), other players' behaviour types and strategic options, and payoff functions (Harsanyi, 1967). A player solves for optimal decisions by starting with a subjective probability distribution on each uncertain variable. The subjective probability is based on personal judgment and bias and differs from person to person. By using subjective probability, a game is converted into its Bayesian Equivalent. It is assumed the probability distribution is mutually consistent across players. The revision of beliefs about the other party's behaviour in every stage is called *Bayesian updates*. The optimized decisions based on Bayesian updates are called *perfect Bayesian equilibria* (Dalkıran & Yüksel, 2016).

Markov Strategies and Markov Perfect Equilibrium

Markovian modelling is used to formulate dynamic economic phenomena with time dimensions (Maskin & Tirole, 2001). The solution concept is based on a Markov process whose current state is controlled by players' actions in its previous state (Gallager, 2012). Each state is defined by an action space for each player. Each period consists of a sequence of states and associated action spaces. Histories are partitions, i.e., collapsing past states into logical partitions and all players operate in the same partition. Each player maximizes payoff as the discounted sum of payoff realized in each state of that period. The *Markov strategies* are measurable to the partition, state-contingent, rationally consistent, payoff-relevant, and non-*bootstrapping* behaviour (Maskin & Tirole, 2001). The behaviour depends not on the history but on variables defining the coarsest partition, e.g., phase-wise planning of a large project. Bootstrapping means both players contingent their strategy on past events because the other player is doing it. The strategies use the following Markov assumptions: (i) *Bygones are bygones*. Decision making and outcomes from that decision are based on action space and information relevant to that subgame rather than the history; (ii) *Minor causes should have a minor effect*. That is, behaviour is sensitive only to significant past; (iii) Only *payoff-relevant* history is needed for decision making. That, is future behaviour is not sensitive to past payoff-irrelevant history; (iv) Preferences over continuation strategies of players

over the history are the same and consistent with the other player in each partition. Two subgames are called isomorphic if player preferences and action spaces are the same in both. In isomorphic conditions, Markov perfection means both games will be played in the same way. *Markov perfect equilibrium* (MPE) is an optimal outcome arrived at by using Markov strategies which are subgame perfect. Advantages of Markov Perfect Equilibrium (MPEs): (i) Partitioning increases predictability by reducing multi-equilibria; (ii) Studies the effect on outcome from narrowed pay off relevant variables and helps in analysing strategic positioning; (iii) Simple to simulate; (iv) Simple strategies help in modelling bounded rationality applications. *Stationary Strategies* are Markov strategies that have the same pattern of behaviour (reaction function) irrespective of other player's response.

Stochastic Games

Stochastic games progresses in steps from state to state by transition probabilities influenced by the actions of players (Shapley, 1953). Each state is called the result of a game played in the previous state. The number of states and player's action choices can be finite. A stopping probability decides the length of the game. Payoff accumulates in every reached state. An action set is called a *behaviour strategy* if it has the same probability distribution when a player reaches a particular state irrespective of the path. It is also called *stationary strategies* as they are time independent. Optimal Strategies are the ones which maximise the player's payoff. A stochastic game is called *concurrent (CSG)* if the state transition is controlled by a joint probability distribution over simultaneous player actions at each state (Kwiatkowska et al., 2019, 2020). A CSG provides a framework to model multi-objective, multi-player, and uncertain phenomena.

Games and Firm Theories

A *Prisoner's Dilemma Game* (PDG) provides framework to formulate the firm theoretic problems having cooperative and non-cooperative motives such as hybrid governance structures (Parkhe, 1993). This game reflects surplus sharing by mutually cooperating (positive sum) and equal investment effect (symmetric payoff). The payoff is designed such that the ex-post opportunistic

behaviour against an investing party gets the maximum payoff (rent from strategic behaviour, unilateral defection, **Temptation** payoff). Parties receive equal payoff when invest truthfully (first-best, mutual cooperation, **Rewards**). Non-cooperative inefficient investment by both parties anticipating ex-post opportunism led to a **Punishment** payoff (Nash equilibrium, mutual defection). Sucker's payoff is the least by being at the receiving end of the other party's opportunism (loss of relationship-specific investment, unilateral cooperation). The payoff distribution is such that $T > R > P > S$. Predictions of the TCE and PRE-GHM reflect the Nash equilibrium payoff (Parkhe, 1993).

A *Stag-Hunt Game* (SHG) is used to formulate cooperative alliances between players (Parkhe, 1993; Santos et al., 2011). In this game form, cooperation offers a higher reward because partner efforts are complementary with higher value within the relationship by capturing a stag, followed by T which reflects the temptation for unilaterally defecting/pursuing an outside option of lower value by capturing a rabbit such that $R > T > P > S$.

Other game theoretic concepts

Complete information: All players know the complete game tree and the payoffs.

Perfect information: Players are fully informed of the actions of all players in the previous state.

Perfect Equilibrium: Equilibrium is an optimal outcome when players take rational actions. The equilibrium excludes the irrational actions of players and the associated outcomes. A behaviour forms a perfect equilibrium if it is repeated in all stages of a repeated game (Selten, 1978).

Imperfect equilibrium: an optimal outcome based on the expectation of one player on the other player's action which the player considers as irrational.

Sequential equilibrium (Kreps & Wilson, 1982): An optimal outcome based on rational moves in extensive games. (i) The player's action is contingent upon his probability assessment on which node (state, action pair) he is in, based on what he believes has happened so far. (ii) Assessments are consistent with what the player believes is the optimal response for that node. (iii) The optimal response of uninformed players depends on sufficient statistics about the opponent (type and action

at the prior stages) based on Bayes' rule and hypothesis about the opponent's optimised future moves. A Nash equilibrium that exists at every node thus arrived or not arrived is called sub-game perfect Nash equilibrium (SPNE).

2.4.3 Repeated Games in Modelling Reputations

Modelling of the reputation effect needs a framework which can link the expected future behaviour of a player to his past behaviour (Mailath & Samuelson, 2015). The framework should allow the construction of short-run incentives e.g. benefit from opportunism, and long-run incentives e.g. reward to promote fairness and punishment to deter opportunism. Repeated games is the framework most used in reputation literature. It helps to model strategic interactions which are both repetitive and behaviorally uncertain. A finitely repeated sequential game is used to model a chain-store paradox with imperfect information in which an incumbent keeps away the new entrants from entry (Kreps & Wilson, 1982). The consistent fight by the incumbent at the early stage coupled with imperfect information creates a future belief among uninformed players that he will fight new entries with positive probability. This small uncertainty introduces asymmetric information introduced in Section 2.3 and can affect the course of the game in favour of reputation builder. It is worth protecting or appearing to protect a reputation until the cost exceeds the total discounted payoff in the rest of the game stages. The aforementioned *adverse selection* approach contrasts with reputation effect literature that uses infinitely repeated stage games (*super games*) with high continuation probability. Super games are *common knowledge* (perfect and complete information)-based that view uncertain behaviour as costly and not an equilibrium strategy. The super games-based approach is also called the *interpretive approach*. The adverse selection approach reduces the problem of multiple equilibria in super games. Similar results were shown in a game to build a reputation for predation tactics (Milgrom & Roberts, 1982). Asymmetric information, i.e., doubts among the entrants in the expected behaviour of the incumbent, amplifies the reputation of the incumbent as a predator in the later stages. The threat of predatory action can be credible since any loss from price cuts can be recouped by gains from the ensuing lack of future competition. The predator is expected to relax its behaviour as the game nears its end, meaning the market is no longer worth the investment in reputation. The value and cost of a reputation for an

incumbent increase in the frequency of its use (number of entry attempts). The frequency depends upon the length of the game (business horizon) and discount factor.

A high discount factor for a player is interpreted in the following ways.

- Risk preference is neutral.
- The probability of the game continuing is high.
- Patient enough to climb from present low performer to high performer perception.
- Willingness to give up a short-term low payoff for a long-term high payoff

In repeated games, a firm is a long-lived player (LLP) with consistent behaviour in its life (Mailath & Samuelson, 2015). The LLP meets either short-lived customers (B2C) or long-lived (B2B) players in succession. Customers deter opportunistic behaviour of firms by choosing myopic /short-term Nash Equilibrium (NE) actions by not paying premium prices. They incentivize truthful investment by choosing cooperative behaviour of paying a premium.

The below section explains both approaches in modelling reputation in Game Theory (Mailath & Samuelson, 2015):

Interpretive Approach to Reputations

In this approach, the (action, payoff) pair of the stage game is designed in such a way that incentives are established to induce mutually beneficial actions in the equilibrium path (Mailath & Samuelson, 2015). A repeated PDG promotes mutual cooperation, and any unilateral defection is retaliated by mutual defection. The player's actions in the equilibrium path are interpreted as reputation-building motivation and those on the deviation path as reputation-losing motivation. By linking the past and expected future behaviour of a player, this approach enables the interpretation of the reputational motivation of the player.

Adverse Selection Approach to Reputations

The linking between past and future behaviour is achieved by a learning process in which the game starts with incomplete information about the player's reputational motivation (Mailath & Samuelson, 2015). The belief updating process involves persistent actions of building, maintaining, and milking one's reputation. Reputation is statistically observable behaviour matched with the experience of the other party. The reputation effect thus created affects the equilibrium payoff.

Social Welfare Nash equilibrium (SWNE)

A player who intends to build a reputation shall take actions of mutual benefit so that the other party responds with similar actions and the repeated games establish a social welfare Nash equilibrium (SWNE) of positive joint surplus (Kwiatkowska et al., 2020). The average per-game outcome is larger than the single-stage Nash equilibrium.

2.4.4 Research Gaps in Theme IV

The following is the list of research gaps identified during the literature review:

- Transitions depend only on the last period game rather than its outcome (Atakan & Ekmekci, 2012).
- Consistency of reputation results between imperfect monitoring of both parties or imperfect monitoring of informed players needs further exploration (Atakan & Ekmekci, 2015).
- The interaction effect of inter-firm reputations is not known (Cabral, 2016).
- Equilibrium characteristics if the players have different discount factors (Lehrer & Solan, 2018).
- Investment in assets based on their interaction effect on their reputations is not known.

- Modelling of next game (inter-firm interaction) based on the outcome of current game for inter-firm reputation is not known.
- The interaction effect of intra-firm and inter-firm reputations is not known.
- Modeling to incorporate empirical knowledge and communication to facilitate coordination and cooperation is not known (Samuelson, 2016).
- Modeling of interactions between multiple selves of the same person at different times is not known (Samuelson, 2016).

2.5 THEME-WISE SUMMARY AND INITIAL CONCEPTUAL CONSTRUCTS

The construct list given in Table 2.1 is derived from each theme and forms the basis for formulating our study. This table also gives the theme-wise inference summary and gap summary relevant to the outcome-based contract concept. The initial conceptual construct is used to guide the literature search and derive a conceptual framework. The framework shall logically relate the constructs with the OBC as the focal point.

Table 2.1

Theme-wise Summary and Initial Conceptual Constructs

Theme	Select Author(s)	Inference Summary	Gaps Summary	Initial Conceptual Construct
IT Outsourcing & outcome-based Contracts	(Dahlberg & Nyrhinen, 2006); (Lacity, Khan, et al., 2017); (Liang et al., 2016); (Selviaridis & Wynstra, 2015); (Cao et al., 2012); (Hou & Neely, 2018); (Böhm et al., 2016); (Kumbakara, 2008)	ITO objective: Cost control, effort-based, billing based on resources used. OBC objective: cost reduction, revenue increase, and billing based on the outcome. Automation assets and digital transformation execution capability.	Inconsistent conclusions from TCE, call for a new framework exists. No single firm theory is sufficient to explain. A muti-theoretic framework recommended. The effectiveness of PRE-II+ TCE for OBC is not known. No empirical study on OBC in IT.	Information and incentive alignment, cost control, Relationship quality, Technological and outcome uncertainty, Cost adaptations & Performance attributability, incomplete contract

Property Rights Economics-ACD Genre, Incomplete Contracts, Transaction Cost Economics	(Coase, 1937, 1960, 1988b; Williamson, 1979, 1985, 1991a); (Demsetz, 1967, 1969, 1997; Foss & Foss, 2015); (Alchian, 1965; Alchian & Demsetz, 1972; Foss & Foss, 2015); (Anderlini & Felli, 2004; Hart, 1988; Hart & Holmstrom, 1986; Hart & Moore, 1999; Maskin & Tirole, 1999b; P.W., 2001; Tirole, 1999)	Categories of ownership— private & government, legal & enforcement institutions. Ex-post transaction costs matter the most to determine control structure. Ex-post opportunism, bargaining & adaptations are costly. Emphasis on cost & ex-post behaviour	Ex-ante underinvestment by parties foreseeing ex-post strategic behaviour is not known to be addressed.	Asset specificity, bounded rationality, strategic behaviour, Frequency of disturbances, Adaptations, Strategic Behaviour (holdup, bargaining) while filling incomplete contract.
Agency Theory, Property Rights Economics-II (PRE-II)	(Arrow, 1984; Jensen & Meckling, 1976; Salanie, 2005; Shavell, 1979); (Hart & Holmstrom, 1986); (Eisenhardt, 1989a); (Grossman & Hart, 1986; Hart & Moore, 1990); (Foss & Foss, 2015; Hart, 1995; Hart & Moore, 1988);	Agency Theory: Ex-ante complete contracting, Incentive alignment, agency cost PRE-II (Property Rights Theory): Incomplete contract, ownership rights provide residual rights of control, allocation to a party with important investment is efficient.	The relevance of ownership of assets on reputation is not known. The behaviour of parties at ex-post is not known to be addressed.	Incentive alignment, asymmetric information, Residual control rights, Asset ownership, Strategic Behaviour (underinvestment)
Reputations, Game Theory & Repeated Games	(Alchian & Demsetz, 1972; Klein, Crawford, & Alchian, 1978); (Hauser, 2017; Kreps, 1990a, 1996a; Kreps et al., 1982b, 1982a; Kreps & Wilson, 1982; Mailath, 2018; Mailath & Samuelson, 2001, 2015; Milgrom &	Reputation effect results in higher-than-normal returns. General and specific reputations. Dynamics – ergodic and path-dependent. Firms cannot be label– - need for real assets.	Investment in assets and OBC execution capability based on the interaction effect of their reputations is not known. Modelling of the next game (inter-firm interaction) based on the outcome of the current game for inter-	Monitoring, commitment type, normal type, patient valuation, impatient valuation, and contract duration. Stochastic Games, Markov Perfect Equilibrium, Nash Equilibrium, and Sub-

	Roberts, 1990); (Camerer, 1991; Phelan et al., 2005; D. G. Ross, 2018; Saloner, 1991; Skyrms, 2001; Zeng, 2003); (Kwiatkowska, 2016; Kwiatkowska et al., 2022)	Stochastic games, Prisoner's dilemma, and stag-hunt game are used to model the reputation effect.	firm reputation is not known. The interaction effect of inter- and intra-firm reputation is not known. The use of stochastic games in modelling OBCs is not known.	game Perfect Equilibrium.
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2.6 CONCEPTUAL FRAMEWORK AND PROPOSITIONS DEVELOPMENT

2.6.1 Introduction

Theory development is a formal strategy which identifies variables, constructs or concepts of a phenomenon and relates them in propositions or hypotheses that remain true over a set of samples (McGrath, 1995). Theory development is classified into: (i) *theory generation* for phenomenon with no or inadequate underpinning theory. E.g. evidence from qualitative studies; and (ii) *theory elaboration* which builds on or advances an existing theory (Eisenhardt, 1989b; Turner et al., 2017). This study elaborates on existing theories of the firms to explain and predict the OBC phenomenon.

The presence of personality, society, meanings, and values make theory building in economic sciences different from that in natural sciences. These subjective human constructs cannot be described as physical configurations (Knight, H, 1957). Hence, in economic theory, there is a need to distinguish between analysis and propaganda. The theory development in economic sciences is approached via: (i) statistical study which leaves out human constructs; (ii) using objectively defined motivation as fact; (iii) using the notion of equilibrium wherein a set of cause-and-effect relations interact in the presence of lag-and-friction between them. The theory development process involves isolating an economic phenomenon and discerning the fundamental tendencies that describe the phenomenon. The process uses reasonable arguments (postulates) through

deductive reasoning and compares the conclusions with the observed facts (Mill, 1889). The comparison needs to consider any divergences between theoretical assumptions and reality, and accordingly, propositions should be revised (Knight, H, 1957). Modern economic science uses modern methods of science in terms of terminology, concepts and thinking approaches.

A *conceptual framework* is a theory elaboration exercise. Philosophically, a *concept* consists of *components* and the concept is defined by those components (Deleuze & Guattari, 1991). The components are distinct, unique, and non-separable from the concept. A component can occur in multiple concepts. A conceptual framework links many concepts that define a phenomenon and provide a fairly thorough understanding of its functioning (Jabareen, 2009). The conceptual framework is a *construction* with an integral role played by each concept. A concept has to be understood concerning its own components or other concepts or other linked concepts (Deleuze & Guattari, 1991; Jabareen, 2009). A conceptual framework based on multiple theories can be built by treating individual theories as empirical data for analysis (Jabareen, 2009). A deductive approach to developing a conceptual framework is an iterative top-down process requiring movement between concepts. All significant concepts have to be embedded from which a researcher can derive propositions with coherent logic and assumptions, and test the propositions empirically (Davis et al., 2007; Williamson, 2012). Any new theory under construction moves through a *natural progression* from the informal (words) to the fully formal(math) stage.

A *model* represents a phenomenon in the form of variables or factors (Jabareen, 2009). The model gives a roadmap and is malleable to fit the specifics of a phenomenon (Solow, 2007). While a conceptual framework offers an understanding and interpretation of a phenomenon, the models provide the analytical setting and theoretical explanation.

The call for well-reasoned theory and the use of mathematical modelling is aired very often in the strategic management literature (Saloner, 1991). A conceptual framework is necessitated whenever a phenomenon needs the organization of existing literature, synthesis of different perspectives, the definition of a concept and its boundaries, reduction of conceptual ambiguity and bringing up conceptual unity (Ghosal, 1987; Karnani & Wernerfelt, 1985; Powell et al., 2011). Any research

process involves theory development, refutation, and application. The following is recommended to govern good research in strategic management (Montgomery et al., 1989): (i) Theory development should be motivated by a phenomenon which is observable and in practice; (ii) Interpretation of a phenomenon should be through theories to identify its constructs and their relationships; (iii) A good theory should be refutable by testing and consistent with existing theories. The rest of this section concerns (i) and part of (ii) crafting a conceptual framework and generation of propositions. Section 3 covers the rest.

Williamson calls governance, incomplete contract, opportunism, contract as a framework, and trust as concepts that are overarching, central, broad, elastic or robust (Williamson, 1979, 1991c, 1999, 2003, 2007, 2009, 2012). Due to a lack of definition, he calls transaction cost an “expansive” concept due to its wide manifestations (Williamson, 2005). He also calls “firm as governance function” as a concept (Williamson, 1985). The theories of reputation and consumer behaviour are called “construction” while the TCE is called the “lens of contract construction” (Williamson, 1991b, 2002a, 2012). Agency theory’s firm-as-production function is called “technical construction” (Williamson, 1998). Asset specificity is called a dimension or attribute of transaction cost and an operational concept (Williamson, 2002b). The PRT uses ownership and residual control rights as concepts to define a firm and explain the relative costs and benefits of various asset ownership forms (Grossman & Hart, 1986; Hart, 1988).

2.6.2 Choice of theories for the conceptual framework

Previous literature on OBCs used TCE-based analysis to identify correlations between the dynamic environments of firms and their specific investments (Kohtamäki et al., 2019). IT outsourcing for creation and capture of value was studied by combining TCE and PRT (Tribble, 2016). A PRT-based study found a positive correlation among quality variations, contract types (development or customization), and asset transfer in IT services (Chang et al., 2017; Shivendu et al., 2020). A similar approach was used to analyse the preference for hybrid governance structures among machine tools and pharma firms (Mazzola & Perrone, 2013) and for vertical integration in French multinationals (Steinwender et al., 2019). A study combined TCE and the theory of reputation to

analyze the outcomes among strategic alliances in the US healthcare industry (Judge & Dooley, 2006). A comprehensive empirical study of the reputation effect was conducted among Indian IT firms (Banerjee & Duflo, 2000).

For this study, the conceptual framework, being a multi-dimensional instrument, requires a set of theories which can complement each other. The chosen set should be capable of spotlighting the critical dimensions of the OBC phenomenon. The set should also neutralize their weaknesses. The contract literature is found to focus on firm behaviour germane to the ex-ante stage such as investment inefficiency and ex-post stage such as bargaining, opportunism and maladaptation. As presented earlier in this section, agency theory and PRT focus on the ex-ante dimension. Agency theory which assumes complete contracting and differential risk preferences is not chosen as the OBC is a case of incomplete contract and risk neutral parties. PRT is preferred as the choice to focus on the ex-ante dimension of the OBC (Fig. 2.7). TCE is the obvious choice for the ex-post dimension (Fig. 2.6). The reputation theory provides the time dimension for the framework by addressing firm behaviour in long-term contracts, contract renewal and extension. Thus, the choice of theories enables the framework of this study on three dimensions. The employment of such a three-dimensional framework for contract analysis is not known in IT outsourcing or OBC literature.

Fig. 2.6 provides the tendencies of efficient organization structures relating to various TCE-based concepts and factors mentioned around the box. Similarly, Fig. 2.7 captures the tendencies of the efficient organization structures at various levels of PRT-related concepts and factors mentioned around the box.

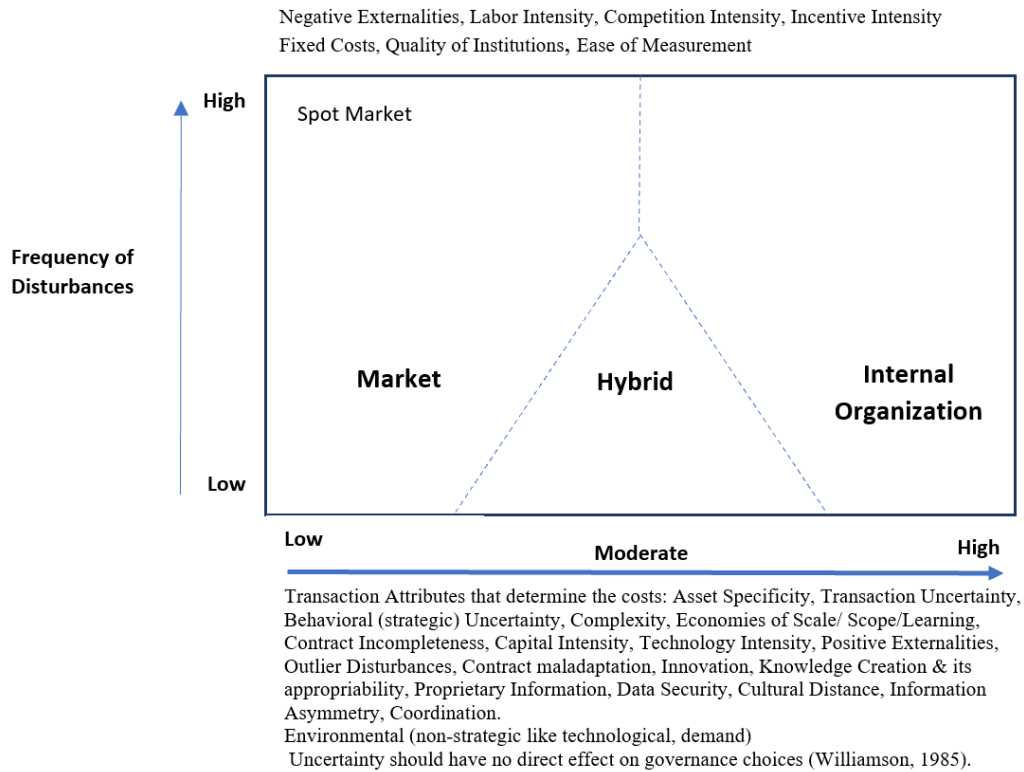


Fig. 2.6. Continuum of governance structures as a function of transaction attributes (Shanmugam & Dhingra, 2023)

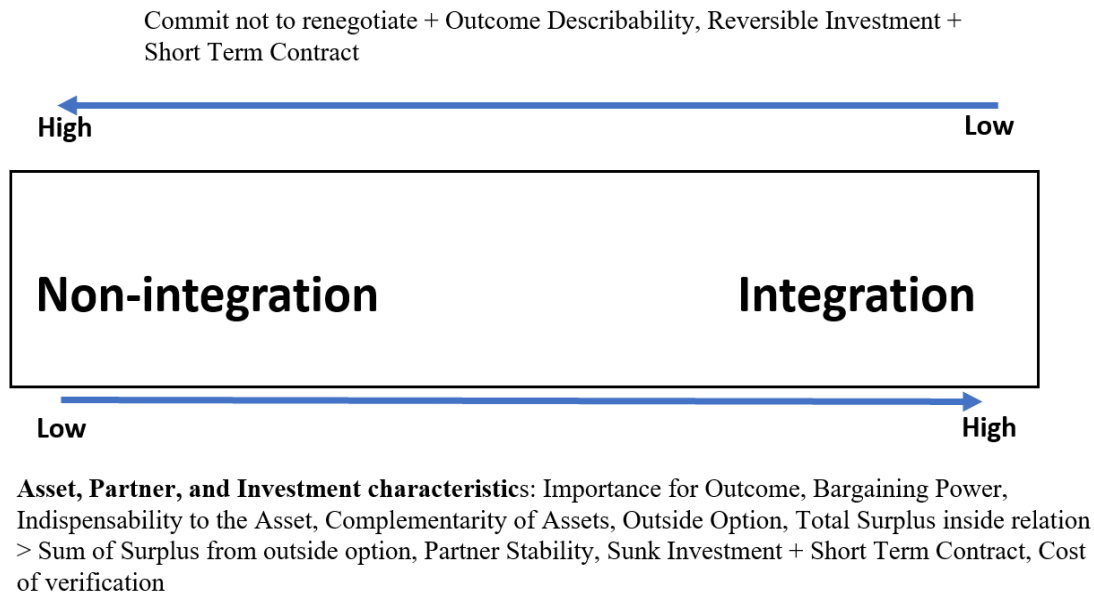


Fig. 2.7. PRT propositions on efficient allocation of property rights as a function of investment characteristics (Shanmugam & Dhingra, 2023).

TCE, PRT and reputation theory intend to increase the *joint surplus*(outcome). The congruence between TCE and PRT is emphasized in the literature as follows. Both theories are built on behavioural consequences of incomplete contracts and authority from asset ownership when parties make relationship-specific investments (Hart, 1989; Maskin & Tirole, 1999a; Williamson, 2010). However, the choice of variables and their treatments are different. Contractible specific investment, ineffective public ordering (courts), costly contract safeguards, and dispute resolution by private ordering ex-post are core beliefs of TCE. PRT considers specific investments as indescribable, non-contractible and non-verifiable, effective public ordering by courts, and efficient bargaining ex-post. Internalization is the last resort in TCE. TCE fixes ex-post rise in costs by switching the transaction to the internal organization. Switching to different structures in the middle of a contract is considered costly. Hence, PRT fixes anticipated inefficiencies by assigning rights of ownership ex-ante to an *indispensable* party with a relatively important investment. The objectives of TCE and PRT are to reduce cost and increase value respectively (Antràs, 2014). Per TCE, the probability of internalisation increases when the quasi-rent of a party rises. In PRT, the same result is obtained when the marginal investment return for a party rises (Whinston, 2001).

The theory of reputation addresses the concepts in the temporal dimension such as faithful adaptation to unforeseen contingencies irrespective of costs (Cuypers et al., 2021; Kreps, 1996a). Because parties of higher reputations adapt for mutual benefit, reputation lowers ex-post transaction costs such as haggling and opportunism (Cuypers et al., 2021). Hence, like TCE and PRT, the intention of reputation theory also is to increase the outcome (*joint surplus*).

2.6.3 Firm behaviour and inefficiencies in the OBCs

The factors that drive inefficiencies ex-ante are a lack of predictability by providers in investment and rate of recovery, customer demand, execution capabilities (Hou & Neely, 2018; Hristov, 2019; Visnjic et al., 2017). The inefficiencies on the customer side are a lack of knowledge of relevant technologies and the ability to evaluate them ex-ante (Böhm et al., 2016). Both parties to an OBC face ex-ante inefficiencies such as contract management skills and asymmetry in information

critical for contract-related decisions (Böhm et al., 2016; Hou & Neely, 2018; Ng & Nudurupati, 2010).

The major inefficiencies faced by providers ex-post include frequent disturbances such as unpredictable contingencies, cost of adaptation to technological and business environment changes, high probability of contract maladaptation and profit declines, inability to use the full potential of evolving technologies (lower scale economy), and margin squeeze by customers of higher bargaining capacity (Böhm et al., 2016; Choi & Cummings, 2016; Hou & Neely, 2018). The customers face inefficiencies ex-post of disincentives to share the information and surplus with providers (Choi & Cummings, 2016; Ulaga & Eggert, 2006).

2.6.4 Uncertainty-reducing AA and Efficiency-improving DT

Technologies can influence the costs and competency of various governance structures (Williamson, 1983). Digital transformation (DT) and automation (AA) demonstrate similar influences. A value chain that uses AA and DT improves on cost and efficiency fronts (Akter et al., 2019; Dubey et al., 2019; Fenwick, 2019; Kraus et al., 2022; Vial, 2019). These technologies can alleviate contract inefficiencies at the ex-ante and ex-post states (Aggarwal, 2018; Agrawal et al., 2018a; Menz et al., 2021; Shankar, 2018; Vial, 2019). The AA, being a prediction device, increases ex-ante efficiencies by accurate predictions, real-time automated responses, reduction in ex-post decision requirements and least wastage of cognitive resources (Acemoglu & Restrepo, 2018b; Agrawal et al., 2018a, 2018b; Autio et al., 2021; Dwivedi, Ismagilova, et al., 2021; Kohtamäki et al., 2019). Decision comprehensiveness enables improved decision tractability in facing exogenous uncertainties (external to the contracting parties, non-strategic) (Menz et al., 2021; Nauhaus et al., 2021). Thus, AA can mitigate consequentiality arising from ex-ante contract inefficiencies. A fine prediction increases the ex-ante describability and contractibility of actions, and it makes transaction cost immaterial (Agrawal et al., 2018a; Farboodi et al., 2019; Hart, 1995; Maskin & Tirole, 1999b; Williamson, 1971). The automation curtails ex-ante insertion of infeasible scope and endogenous uncertainty such as strategic behaviour via automated

monitoring, drafting, and enforcement of contracts (Cuypers et al., 2021). The ex-ante contract role of the AA demonstrates its specialization in value creation.

Digital transformation is shown to alleviate ex-post inefficiencies significantly (Autio et al., 2021; Kohtamäki et al., 2019). The DT acts as a centrifugal force when capturing value from specialized tasks across geography and as a centripetal force when value flows from routine tasks (Autio et al., 2021). The DT enables organization malleability to respond to existential and routine adaptation demands in exogenous and endogenous environments (Hanelt et al., 2021). It improves efficiency in labour allocation between routine and new tasks of human advantage and thereby increases aggregate outcome (Acemoglu & Restrepo, 2018b, 2018c). The ex-post-contract role of the DT indicates its specialization in value capture.

This study synthesizes the above analysis to visualize the OBC as a mutually reinforcing interaction effect of AA and DT as shown in Fig. 2.8.

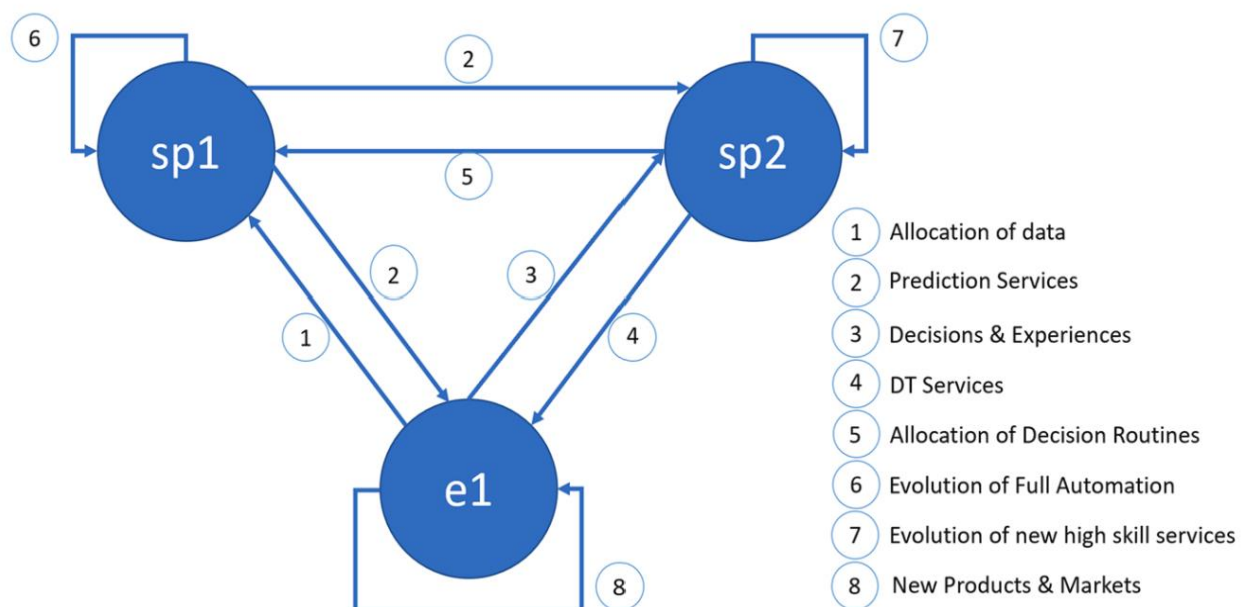


Fig. 2.8. Process of reputation generation from investment on AA, DT, and allocation of ownership

2.6.5 Proposition development

This section distils the characteristics that uniquely identify an outcome-based contract in ex-ante, ex-post, and time dimensions. The treatment of these characteristics in TCE, PRT and reputation perspectives are logically related to formulate propositions about the phenomenon. The propositions are tested for plausibility and explanatory power.

Transaction characteristics of the outcome-based contract

The OBC incentivizes ex-ante efficient results if the outcome is contractible, the outcome-sharing rule is aligned, assets are complementary, and access to assets including information is agreed upon (Ng & Ding, 2010; Ng & Nudurupati, 2010). The contract should aim for improved communication with information symmetry and IT-business alignment (Choi & Cummings, 2016). Performance monitoring, coordination capabilities of IT and managerial staff, observability of individual and joint production, and long-term collaboration are essential (Guajardo et al., 2012; Han & Mithas, 2013; Ulaga & Eggert, 2006). The outcome has symmetric dependence on the parties' investments and it is shared equally between them (Awasthy & Hazra, 2020; Roels et al., 2010). Parties have equal risk preferences and outcome valuation, equally important investments, and surplus sharing based on equality of asymmetric resources are the characteristics of successful OBCs (Jap, 2001).

Parties have balanced bargaining power, symmetric credible commitment and trust for coordinated adaptations to disturbances, and ownership of technology and production assets (Dey et al., 2010). Parties should have an existing or past relationship (Böhm et al., 2016; Schaefers et al., 2021; Ulaga & Eggert, 2006). The task list of the contract is feasible for a combination of prediction, judgment and default decisions whose distribution gravitates towards full automation by continuous investments (Agrawal et al., 2018a). Investments in reliability and operational readiness promote ex-post efficiency in the OBCs (Guajardo et al., 2012). Perpetual redistribution of ownership rights balances the bargaining power through the length of the contract (Dey et al., 2010). Perpetual governance of specific investments, boundary redefinition and incentive

alignment are critical for contract success (Böhm et al., 2016; Choi & Cummings, 2016; Hou & Neely, 2018; Hypko et al., 2010; Ng & Ding, 2010; Roels et al., 2010).

Proposition 1: Reputation effect on governance costs

The reputation-building parties choose investments that are mutually beneficial with the belief that the contract would continue for long (discount factor ≈ 1). These patient parties tolerate the consequences of contract incompleteness because they give equal weightage to both present and future revenues by setting a discount rate ≈ 0 (Aghion & Holden, 2011; Kreps, 1996a). Thus, the reputation effect promotes coordinated adaptations in highly specific investment environment of the OBCs that equally influence individual and total benefits and attenuate opportunism. The reputation effect in the TCE improves the comparative efficacy of hybrid contracts over hierarchy (Williamson, 1991a: 285, 291). The high discount factor tends to blur the boundary between contracting parties by substituting for each other's interest. The long-term contract relationship between parties of reputation is analogous to the relationship called a firm (Coase, 1988a). This logical derivation is substantiated by empirical studies which found integration and reputation as substitutes since the cost of governance is equal (Garvey, 1995). Another study found that opportunism and reputation are negatively correlated (Judge & Dooley, 2006). Hence, this study calls the contract relationship between parties who invest in reputation a *reputed hybrid*. The reputed hybrid in repeated relationships equals the cost and competency of vertical integration in handling contract incompleteness (Tirole, 2009). Accordingly, the efficacy of the reputed hybrid governance structure is updated as shown in Table 2.2. The reputed hybrid enables the OBC phenomenon's main characteristics of information sharing and open communication for mutual gain from the outcome. Thus, it meets the TCE's viability requirements (Williamson, 2008).

Table 2.2

Adaptive capacities of governance structures: Reputation effect (P1) on hybrid's adaptive capacities

Type of Adaptation	Market	Hybrid	Internal Organization	Reputed Hybrid
Type-I (strictly autonomous response to own opportunities)	Very High	High	Moderate	High

Type-II (mainly autonomous)	Moderate	Very High	Low	Very High
Type-III (mainly cooperative)	Low	Moderate	Moderate	Moderate
Type-IV (strictly cooperative)	Very Low	Low	Moderate	=> Moderate

By synthesizing TCE, reputation theory, OBC characteristics and ex-ante/ex-post inefficiency deterrence potential of AA and DT, the following proposition is derived:

Proposition 1 (P1): For a provider with ownership of AA and DT capabilities, there exists a reputation level $o^ \in (0, 1]$ at which the provider is a substitute to its customer in providing OBC services.*

Proposition 2: Allocation of ownership and reputation effect

A comparatively efficient ownership structure yields the highest joint surplus in a contract relationship if it : (i) increases the marginal benefit to one party by not increasing the marginal cost to the other party; (ii) decreases the marginal cost to one party by not decreasing marginal benefit to the other party; (iii) minimizes investment inefficiencies and maximizes the surplus; (iv) provides incentives to the party whose investment is important to the surplus; (vi) maximizes the responsiveness of the surplus to investments in inter-dependent assets (physical or human) in terms of their complementarity, independence and dispensability (Hart, 1995). The larger the proportion of the assets in a specific contract relationship, the more significant the marginal returns of the producer. An efficient ownership structure maximizes value captured from the assets in a relationship and minimizes externalities such as loss by bargaining and value spillover. The ownership structure is inefficient if it permits an opportunistic player to capture an undue surplus or an overinvestment that compensates for a party's underinvestment. The PRT prediction of distorted investments and gain from defection renders joint ownership suboptimal (Hart, 1995). Thus, standard PRT does not explain joint ventures and other two-party arrangements.

The sharing rule reflects the ownership structure (Garvey, 1995). The condition of equal investment and its effect on the outcome in an OBC reflects a 50:50 sharing rule of joint ownership. A joint ownership structure in an environment of reputational concerns discourages opportunistic

behaviour because the future loss from contract termination will be more significant than the gain from defection. If continuous investments are from indispensable agents, a vital attribute of an OBC transaction, then joint ownership structure in repeated relationships is efficient (Halonen, 2002). Any hold-up situation minimizes cooperation and hence the surplus (Hart, 1995; Rajan & Zingales, 1998). In markets with strong reputation concerns, the probability of holdup falls, and the relevance of joint ownership rises. In such markets, the benefit of integration is lower compared to the costs of integration such as bureaucratic costs and diminishing returns to management. Hence, joint ownership supersedes integration.

Going by the characteristics of OBCs, the two sets of assets from the contracting parties (AA/ DT capabilities from the provider, and production/marketing from the customer) are complements. The rise in outside options and bargaining power (Grossman & Hart, 1986), is neutralized in OBC characteristics of equal investments and equal effect on the outcome. The OBCs let parties into an environment of equal outside options. This conclusion is consistent with (Schmitz, 2008). It is re-emphasized that there is a perpetual governance of joint ownership structure so that each party's investment raises the joint surplus (Che & Hausch, 1999; Whinston, 2001). This spillover effect is due to the substitutability between specific investment and general investment. This result is obvious for human capital wherein an increase in outside options due to a partner's investment is higher than that from one's investment (Gattai & Natale, 2016). If general and specific investments are substitutes with investment spillovers and consensual access to assets is permitted, then joint ownership results in the least investment distortions (Bel, 2013; Cai, 2003; Gattai & Natale, 2014). Veto rights exclude the assets from outside options without consent by all parties and increase the incentive for specific investments. This derivation is consistent with IT outsourcing literature wherein ownership of data is not normally assigned to providers in a traditional contract (Y. Chen et al., 2017). Veto rights meet the necessary conditions posited by the providers for greater control of assets in the OBCs (Infosys, 2018). Joint ownership prohibits under-investing in specific investments and over-investing in general investments and plays the mutual commitment mechanism for the transaction (Bel, 2013). Experiments in behavioral economics such as equity aversion found joint ownership as relatively efficient (Fehr et al., 2008). The cost of governing joint ownership is low if parties to the contract have the same risk preference (Bel, 2013), which

is a characteristic of the OBCs. This conclusion explains the emergence of the OBCs of hybrid structures in practice.

Hence, it is logical to state the following proposition:

Proposition 2 (P2): Joint ownership of complementary assets with veto rights is the most appropriate structure for OBC transactions.

Proposition 3: Intra-firm reputation effect

Intra-firm reputation resists opportunistic behaviour among management staff of a focal firm (Williamson, 1991a). Intra-firm reputation leads to a fall in the cost of governance of hybrid arrangements entered by the focal firm with other parties. The marginal benefit of a buyer rises if the purchased product is from a firm which maintains a reputation for multiple products (Huangfu et al., 2016). E.g., Apple. If a firm maintains a firm-level general reputation and a product-level specific reputation, the general reputation will have a larger impact on a bad news (Chandler et al., 2020). A survey of Chinese firms found that the general reputation acts as a buffer to attenuate value loss from a crisis when a specific reputation is a burden (Wei et al., 2017). Conversely, a general reputation wears out if a specific reputation dominates. When a party faces adverse events not controllable by itself, the other contracting party values the focal party's *capability reputation* higher compared to the *character reputation* (B. Park & Rogan, 2019). The first buffers new relationships and the second buffers existing relationships. Some firms build and maintain reputations of diverse and conflicting nature (Harvey et al., 2017). E.g. Walmart maintains conflicting reputations of *being tough* against suppliers and *being good* with customers (Carter & Deephouse, 1999). Homogeneity among reputations is a must since any incongruence risks ambiguous perception (J. S. Park & Rhee, 2021).

The AA and DT with distinct specialization against ex-ante and ex-post inefficiencies form a mutually reinforcing virtuous cycle through an incremental asset transfer (Fig. 2.8). The virtuous cycle leads to an increasing proportion of automation in the ex-ante phase. The DT capability

differs for each customer implementation (Vial, 2019). Since the AA is a general-purpose technology (Brynjolfsson & McAfee, 2017). Hence, it can be concluded that AA is the general reputation and DT is the specific reputation of the provider. Any contract-specific non-performance may hit the reputation of DT negatively. Similarly, any breakthrough in automation will positively affect the reputation of AA. Effective reputation is determined by the interaction effect of these intra-firm reputations as proposed below.

Proposition 3: Intra-firm reputation interaction at service provider (P-3) : (i) Investment incentive to AA as general reputation decreases in DT as specific reputation. (ii) Any rise in one of the reputations counters the fall in other reputations and vice versa.

Proposition 4: Inter-firm reputation effect

The governance cost between hybrid and hierarchy narrows if inter-firm and intra-firm reputations prevail in a market which enforces faithful actions at the firm level and manager level (Williamson, 1991b). Inter-firm reputation has been a cornerstone in the IT services industry for a long time (Banerjee & Duflo, 2000). The level of cooperation found in a hybrid governance structure is a function of the partner's reputation information (Arend, 2009). The reputation of parties in a partnership elicits cooperation not only from their employees but also from suppliers and other stakeholders. Thus, the inter-firm reputation has a positive effect on intra-firm reputations (Money et al., 2010). When two parties trade, reputation transfer takes place in the same direction (move up or down together) via inter-firm reputation interaction. Venture capitalists with premium-priced IPOs in the past, were able to get similar prices for current launches (Chahine et al., 2021). The banks are found to boost their reputation by retaining customers of high reputation (Podolny, 1993). Similarly, colleges boost their reputation by a direct transfer of reputation from their affiliated universities (Brewer & Zhao, 2010).

A reputational damage of a firm is found to damage the reputation of the industry to which the firm belongs, e.g. oil spill (Zimmerman & Zeitz, 2002). Inter-firm reputation has a positive effect on knowledge transfer between firms (Huang et al., 2021; Low & Robins, 2014). A control

of jointly owned assets results in a party benefitting from the investments of the other party in brand and other intangible assets (Gattai & Natale, 2014).

One can infer from the above analysis that inter-firm reputation facilitates information symmetry, access to assets, and observability of actions required in the OBCs. This inference supports the next proposition:

Proposition 4: (P4): (i) Inter-firm reputations affect the performance of outcome-based contracts in the same direction. (ii) Outcome-based contract transfers reputations such that the higher the reputation of the customer, the higher the reputation of the provider.

In summary, a literature search on outcome-based contracts, incomplete contracts, outcome uncertainty, incentives to invest and strategic behaviour in contracts led to the theories of the firms. To emphasise the contract nature of the problem phenomenon, theories under the lens of contract – TCE, PRT and reputation are chosen to build the framework. These three theories are used to unravel the inefficiencies in the ex-post, ex-ante, and temporal dimensions of the OBCs. Further reviews conducted on automation and digital transformation literature unraveled their mitigation capabilities vis-à-vis these three dimensions. The concepts in these themes are related logically to derive the propositions which explain the OBC phenomenon in the context of hybrid contracts.

3. RESEARCH DESIGN AND METHODOLOGY

3.1 RESEARCH PROBLEM

A complex contemporary phenomenon forms a research problem both in social science and in applied science (Yin, 1994). The literature covers cases of inter-firm hybrid governance arrangements for OBC transactions such as (i) service offering to automate customer process for cycle time reduction by iOpex (Moore, 2021); (ii) improved delivery efficiency for FedEx Supply Chain by Dell (Frydinger et al., 2019); (iii), near-store retail demand prediction by Centricity (Castellanos, 2021); (iv) outcome-based ATM network by TCL to Citibank (Awasthy & Hazra, 2020); and (v) reduced drug development cost for Bristol Meyers Squibb by Owkin (Kuchler & Cookson, 2022). A pattern in these contracts is that firms tend to realize an outcome which is larger than what was currently achieved using their own assets. These contracts substitute the providers for an internal function of customer organization which is hitherto unallowed for outside parties. Another pattern is the leverage of digital technology assets such as AA and DT. The above strategy to deliver the OBCs has evidence in practice. Debashis Chatterjee, CEO of LTI, an IT firm, considers the efficiencies derived by leveraging AA and DT to meet OBC objectives (Aggarwal, 2018). Rostow Ramanan, Former CEO, of Mindtree, believes that a fall in human-effort-based billing and a rise in automation-based effort in IT value delivery drive the industry to the OBCs (Shankar, 2018). IBM has decided to invest in AA and DT to pursue outcome-based opportunities (Cornell, 2020). Hence, ownership of digital technology assets such as AA and DT is essential to pursue OBC opportunities.

The literature review in Section 2 found the following critical characteristics of the OBCs: (i) high relationship-specific investments and risk of strategic behaviour (Guajardo et al., 2012; Hou & Neely, 2018; Ng & Ding, 2010); (ii) incomplete contracts and costly coordinated adaptations to uncertainties (Böhm et al., 2016; Choi & Cummings, 2016; Roels et al., 2010); and (iii) need for complementary assets from contracting parties (Awasthy & Hazra, 2020; Ng & Ding, 2010; Schaefer et al., 2021). For such contract attributes, both TCE and PRE recommend *common ownership* is comparatively efficient to protect against market or hybrid-based inefficiencies such

as underinvestment, opportunism, and non-cooperative outcome. This begs the question of how inter-firm hybrid governance structures are used for the OBCs in practice. This reality confirms the insufficiency of TCE and PRT in explaining contract phenomena operating in complex and digital environments (Menz et al., 2021). This shows that TCE and PRT are missing something in the OBC phenomenon. This led to the inclusion of the firm's reputation as a potential missing mass in this study. This inclusion is supported by literature which recommends *known relationships* for partner choice (Hou & Neely, 2018; Schaefer et al., 2021; Ulaga & Eggert, 2006). Industry analysts are also gauging the reputation of service providers in outcome-based services (Jain & Mondal, 2018; Marks, 2016; Maschio et al., 2019; C. F. Ross, 2017; Schadler, 2022).

The following research problem statement is derived from the above analysis:

How a hybrid (inter-firm) outcome-based contract as a function of service provider reputation overcomes incomplete contract due to bounded rationality, outcome uncertainty, strategic behaviour, inefficient investment and other ex-ante and ex-post contract inefficiencies.

3.2 RESEARCH PURPOSE

The intention of the researcher and what he wants to achieve overall in a research study are indicated in the research purpose (Creswell, 2009). The purpose is either *exploratory*, *explanatory* or a *combination* (Saunders et al., 2009). An *exploratory study* seeks to gain insights into a phenomenon by investigating what is happening in it or assessing it in a new light. An *explanatory study* explains the relationship between concepts or variables that depict a research phenomenon. The exploratory or explanatory nature is determined by the purpose and the questions set forth.

The purpose is to delve into service provider strategies that successfully realise outcome-based contracts even though the contract faces potential inefficiencies. The study intends to explain how the interaction of technology, ownership and reputations implement investment incentives and

safeguards in a successful outcome-based contract. This is in contrast to the earlier focus of the studies on the cost-saving ITO phenomenon (Lacity, Yan, et al., 2017; Liang et al., 2016). This study focuses on the providers of ITS services and overlaps with the equipment manufacturers who strive to become digital companies. The technology focus is on automation powered by artificial intelligence and digital transformation.

Theoretically, the focus is to discern the effect of the reputation of the contracting parties which is often obscured in the TCE and PRT (Hart, 1988; Williamson, 2003, 2008). The proposed framework develops insights built on three concepts and their interactions—economising transaction costs, incentives from ownership and truthful adaptations of reputation effect. Methodically, this study models the contract in a probabilistic temporal logic environment reflecting the multi-player, uncertainty and reputational aspects of the OBC phenomenon (T. Chen et al., 2013).

This study intends to highlight the insights a researcher can derive from a three-dimensional lens and probabilistic temporal logic in studying a multiplayer strategic phenomenon. From practitioners' perspective, the study intends to develop strategies as a function of technology, ownership, and reputations to incentivize and safeguard the OBCs.

3.3 RESEARCH QUESTIONS

The literature review has revealed the critical dimensions in whose intersection the solution can be found – technology assets (AA and DT), ownership or governance structure, and firm reputations. The following questions are used to guide the study to meet its purpose.

RQ1. What is the relationship between ownership of assets by service provider and reputation?

By examining the relationship among technology, ownership and reputation, the study intends to explain and predict the relationships by deductive reasoning and interpretation.

The relationship helps firms determine how their investments in assets can be controlled to influence their reputations to a desired level. Here, explanation equips prediction which in turn equips control (Saunders et al., 2009).

The following additional questions are raised to discover the implementation details.

RQ2. How can investment in assets be optimized at various stages of business to establish OBC execution capability as reputation?

RQ3. How does inter-firm interaction happen and stabilize in OBC project as a function of service provider reputation?

RQ4. How do inter-firm and intra-firm interactions influence the OBC service offering as a function of service provider reputations?

3.3.1 Nature of Research Questions

All the research questions are explanatory about an emerging phenomenon. They relate the variables/constructs from critical dimensions and explain their sensitivity in determining a successful OBC from the provider's perspective.

3.4 RESEARCH OBJECTIVES

The study wants to achieve the following.

1. To establish the relationship between ownership of assets by service provider and reputation.
2. To find out the pattern of investment optimization on assets at various stages of business to execute OBC as reputation.
3. To study the process of establishing service provider reputation through inter-firm interaction in the OBC project.

4. To study the process of establishing service provider reputations through inter-firm & intra- firm interaction in the OBC project.

3.5 PHILOSOPHICAL ASSUMPTIONS

A researcher should explain the philosophical perspectives or worldviews adopted which will, in turn, explain the chosen methods for the study (Creswell, 2009). Research philosophy suggests that the basic beliefs, ideas, and orientation of a researcher are shaped by his education and experience. The philosophy guides the decisions of a researcher concerning: (i) what he considers as the form of new knowledge (*epistemology*); (ii) the objective and subjective nature of reality (*ontology*); and (iii) whether the researcher is neutral or intervenes in the interpretation of reality (*axiology*). As suggested (Creswell, 2009 p6), this section presents the justification for the philosophical position.

The following table summarizes the philosophies used in research studies (Saunders et al., 2009).

Table 3.1
Philosophies and corresponding ontological and epistemological choices

	Positivism	Interpretivism	Pragmatism
<i>Ontology</i>	Objectivism – the phenomenon is independent and definitive.	Subjectivism – phenomenon is continuously changing and requires interpretation.	Multiple views and research questions determine the choice.
<i>Epistemology</i>	phenomenon contains primitive elements, Observable data is credible, and cause-effect rules.	Detail of a phenomenon and its subjective interpretation by researcher matters.	Either or both observable data and subjective meaning of the detail matters. Suitable for applied research which involves human behaviour.
<i>Axiology</i>	Researcher is neutral and objective with respect to data.	Researcher is subjective and cannot stand out of the problem phenomenon.	Values are critical in human behaviour; researcher is both objective and subjective.

3.5.1 Research Approaches

The two approaches which a researcher adopts for their research projects are: (i) *deductive* in which the researcher studies the theoretical concepts that define a phenomenon, and logically relates them to develop a theory with testable propositions and tests in a sample of quantitative data; (ii) *inductive* in which the researcher finds patterns in the qualitative data generated by a phenomenon and interprets the pattern to formulate the theory (Saunders et al., 2009). These approaches fit for positivism and interpretivism respectively.

3.5.2 Epistemological, ontological, and axiological position for the study

The emerging phenomenon of outcome-based contracts falls under the overarching phenomenon of contracts which has well-established foundational theories grouped under the lens of contract (Williamson, 2003). TCE and PRT are unable to explain and predict the new generation of contracts which involve blurred boundaries such as OBCs (Cuypers et al., 2021; Kohtamäki et al., 2019; Menz et al., 2021; Selviaridis & Wynstra, 2015). Current OBC studies use theoretical assumptions implicitly and are dominated by qualitative research (Rabetino et al., 2018). The qualitative research does not include the IT services domain. So, there are both theoretical and empirical limitations in the OBC literature. Hence, OBC literature calls for adopting theoretical pluralism with well-established theories that generate novel understanding (Kohtamäki et al., 2019; Menz et al., 2021; Rabetino et al., 2018; Sjödin et al., 2019). Hence, the chosen method should support confirmatory and quantitative strategies to derive and test novel propositions.

Theory development in mainstream economics mostly adheres to the deductive method (Lawson, 1996). The positivists in strategic management literature consider theories with unobservable constructs such as human behaviour to be useful for prediction purposes (Godfrey & Hill, 1995). Such theories are not capable of informing the structure of reality. These theories are also explanatory and not exploratory. By emphasising operationalization and prediction, and assuming the unobservable human behaviour as being selfish, the TCE and PRT demonstrate objectivist and deductive ways of explanation and positivism-based view (Pratten, 1997). The theory of

reputation is also objectivist, deductivist and positivist by assuming a high discount factor and positive gain from cooperation.

To fill the aforementioned philosophical, theoretical and empirical gap, research method literature recommends a mixed method (Östlund et al., 2011; Saunders et al., 2009; Tashakkori & Teddlie, 1998). The mixed method helps to deduct rigorous theoretical frameworks, derive propositions, and verify the same over data. The inference gained can be used to modify or expand the theory. Moreover, the explanatory nature of the research questions requires a deductive approach (Saunders et al., 2009). The constituent theories of the proposed framework are of deductive and explanatory types. The epistemology of mixed method is a *pragmatic* knowledge claim (Creswell, 2009, p17) which is a continuum of philosophical choices that focuses on the research problem. This choice also facilitates the pragmatism of the researcher to stand apart from what is being studied (positivism) as well as interpret by letting the knower inform the known (Tashakkori & Teddlie, 1998).

3.6 RESEARCH METHOD

The research strategy depends on questions, objectives, and philosophical positions. Some of the research strategies are: (i) *Experiments* are used in natural science, to study causal relationships by using differential calculus – how changes in independent variables affect a dependent variable – the sign (positive or negative) and the size of the change. Experiments are both explanatory and exploratory to answer what, why and how questions; (ii) *Surveys* are used to answer what, how, and where type questions in exploratory research. Both experiments and surveys suit deductive approaches; (iii) *Case studies* are a combination of explanatory (questionnaire research) and exploratory (interviews). They answer questions of why, what, and how types. Case studies involve both quantitative and qualitative data and are integrated by triangulation; (iv) *Grounded theory* is an interpretive approach wherein data collection is performed without a theoretical framework, and predictions are derived from observed data patterns which are tested on future observations. It is called *grounded* because of the continual connection to the phenomenon in theory development and testing. Thus, grounded theory uses both inductive and deductive approaches. The strategy can

be either *mono-* (qualitative or quantitative types), *multi-* (more than one qualitative or quantitative) or a mixed method (both types) (Saunders et al., 2009). Combining both types cancels out the limitations of its constituent methods by using their strengths (Turner et al., 2017). Thus, a mixed method enhances the knowledge about the research questions. It fulfils the theoretical purpose of development and testing of theories and ensures *construct validity and generalizability* by meeting the methodological purpose as well. The linking of methods is called *triangulation* which improves understanding of a phenomenon and the associated theory (Turner et al., 2017).

The conceptual framework developed in Section 2.6 underpins this study. When a phenomenon lacks theoretical and empirical limitations, as in the case of OBC, a mixed method underpinned by a conceptual framework is preferred (Creswell, 2009; Davis et al., 2007). The data collection underpinned by a conceptual framework meets the *context authenticity* of methodological purpose (Jabareen, 2009; Turner et al., 2017). This approach is also called *concurrent transformative design* (Creswell, 2009; Kroll & Neri, 2009). The epistemological choice of pragmatism fits the what and how type of research questions raised in this study, and provides freedom to choose methods for theory verification and refinements (Creswell, 2009, p11). Pragmatism also supports this study's aim of doing practical applied research and axiological choices of objective and subjective views (Saunders et al., 2009, p 119). This study contains an objective simulation-based quantitative method and a subjective open-ended essay questions-based qualitative method. This study uses *concurrent triangulation* of the findings from both methods to compare for *convergence, complementarity or divergence* at the interpretation stage (Östlund et al., 2011).

By giving both findings an equal weightage (Creswell, 2009), the studies become focused and tractable. The concurrent transformative design offers (Creswell & Creswell, 2017): (i) scope for participants to interpret and inform a phenomenon in the ways they perform in their job functions; (ii) strengthen the validity of quantitative findings from practitioners' perspective; (iii) stretch and refine the finding from conceptual study using the practitioners' experience and wisdom; (iv) neutralize the bias from each finding; (v) unify the findings to meet the knowledge aspiration of academicians and practitioners; (vi) iron out the convergence or divergence of findings. Hence,

the researcher aims to (i) represent the components of the phenomenon as functional forms that can be used to test the propositions in a simulated quantitative environment; (ii) assess the consistency of the theoretical results against the understanding among practitioners by using a qualitative method; (iii) triangulate the findings for integrated results.

3.6.1 Mixed Method chosen for the study

The following mixed research method had been chosen contingent on the lack of theoretical and empirical limitations of the OBC phenomenon, non-disclosure agreements by firms that prohibit contracts from being analyzed by third parties and Covid-driven work-from-home policies that prohibit contact-based research methods :

- (i) Develop a conceptual framework with testable propositions (Section 3.6) that guide the data collection, analysis, and validation.
- (ii) Model checking and simulation as a quantitative method in the following environment.
 - Concurrent stochastic game (CSG) is a formulation to study and analyse the strategic interaction of multi-objective players in a probabilistic context (T. Chen et al., 2013; Kwiatkowska et al., 2020). OBC, which is a multi-player and multi-objective phenomenon in an uncertain environment, fits best for CSG-based modeling.
 - Functional forms of productive assets (AA and DT) are used as player behaviour to explore their interactions.
 - Repeated games-based modelling is recommended in reputation literature (Halonen, 2002; Kreps et al., 1982b; Kreps & Wilson, 1982).
 - PRISM-games provide probability and reward operators to simulate outcome production and reputation generation in an uncertain environment.
- (iii) Open-ended essay questions as a qualitative method
 - Popular tool to gain rich insights from unlimited text-based responses (Chaudhary et al., 2022).

- Effective tool for performing experiential assessment (Bennion et al., 2020).

Propositions are tested independently in both methods and triangulated as shown in the table below.

Table 3.2
Theoretical Contribution, Research Questions & Objectives.

Research Gaps	Propositions	Research Question	Research Objective	Research Methodology
Relevance of ownership of assets on reputation is not known.	Proposition 1 (P1): <i>For a provider with ownership of AA and DT assets, there exists a reputation level $o^* \in (0, 1]$ at which the provider is a substitute to its customer in providing OBC services.</i>	1. What is the relationship between ownership of assets by service provider and reputation?	1. To establish the relationship between ownership of assets by service provider and reputation.	Model checking+ Simulation + Open-ended essay method
Investment in assets and OBC execution capability based on interaction effect of their reputations is not known.	Proposition 2 (P2): <i>Joint ownership of complementary assets with veto rights is the most appropriate structure for OBC transactions.</i> Proposition 3: Intra-firm reputation interaction at service provider (P-3) <i>:(i)Investment incentive to AA as general reputation decreases in DT as specific reputation. (ii) Any rise in one of the reputations counters the fall in other reputations and vice versa.</i>	2. How can investment in assets be optimized at various stages of business to establish OBC execution capability as reputation?	2. To find out the pattern of investment optimization on assets at various stages of business to execute OBC as reputation.	Model checking+ Simulation + Open-ended essay method

Modelling of next game (inter-firm interaction) based on the outcome of current game for inter-firm reputation is not known.	<i>Proposition 4: (P4) :(i) Inter-firm reputations affect performance of outcome-based contracts in the same direction. (ii) Outcome-based contract transfers reputations such that higher the reputation of the customer, the higher the reputation of the provider.</i>	3. How does inter-firm interaction happen and stabilize in OBC project as a function of service provider reputation?	3. To study process of establishing service provider reputation through inter-firm interaction in OBC project.	Model checking + Simulation + Open-ended essay method
Interaction effect of intra-firm and inter-firm reputations is not known.	The Model	4. How do inter-firm and intra-firm interactions influence the OBC service offering as a function of service provider reputations?	4. To study process of establishing service provider reputations through inter-firm & intra-firm interaction in OBC project.	Model checking+ Simulation + Open-ended essay method

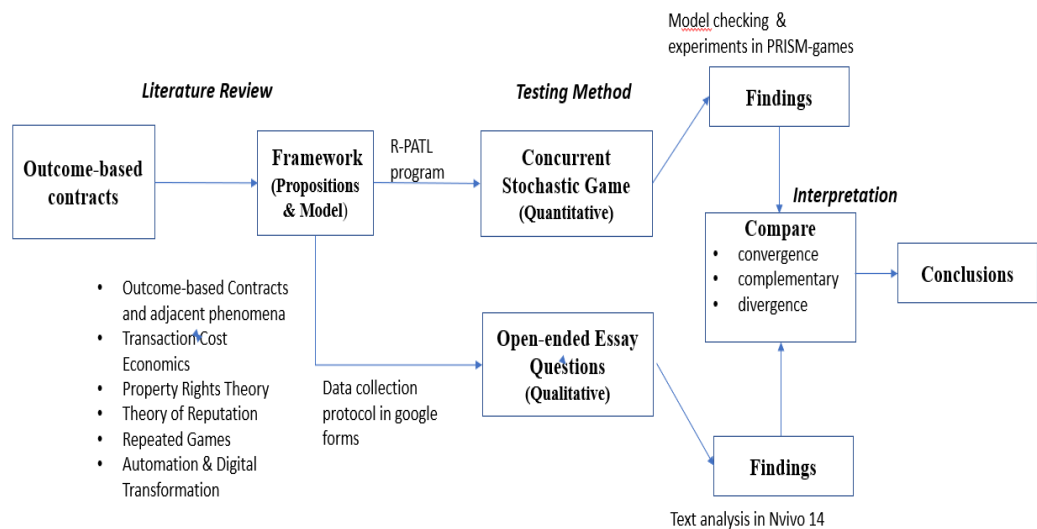


Fig. 3.1. Research design

3.7 VALIDITY AND RELIABILITY

This section presents the steps taken to meet the requirements of *validity* i.e. whether the findings are the ones as reported, and *reliability* i.e. yielding consistent findings in terms of measures, observations and transparency in interpretation if another researcher replicates the study (Saunders et al., 2009).

3.7.1 Construct Validity

Ensuring that the concepts identified in a study to describe the problem phenomenon are measured correctly is called *construct validity* (Yin, 2003). Evidence shows that mixed methods of research and their triangulation improve construct validity. Triangulation of data from qualitative and quantitative approaches helps in corroborating the same phenomenon since the multiplicity of respondents and their experiences bring different factors to light (Yin, 2003). It helps substantiate the findings from each method and improves the inference (Eisenhardt, 1989b; Rossman et al., 1984). A major strength of the qualitative approach is the combination of different respondent sources (Yin, 2003). The study ensured construct validity as follows. (i) The choice of mixed method cancels out the weakness in each method by the other's strength (method effect) (Saunders et al., 2009). (ii) Markov chain-based model checking and simulation in PRISM-games against specification ensured construct validity in the accuracy of specification. The software platform avoids the threat of construct validity (Creswell, 2009). (iii) By combining simulation results with a qualitative study, validity was strengthened from the practitioners' perspective. (iv) Using the constructs of the conceptual framework as functional forms of the quantitative study and as themes of the qualitative method ensured construct validity between methods. (v) Google Forms is used to organize the data along with the correct attributes in a spreadsheet so that analysis is error-free. (vi) Text counting and relationship analysis in Nvivo ensured that concepts and their relations were correctly identified and measured. (vii) The instruments – PRISM-games, Google Forms and Nvivo were used consistently. No change of instrument was made in between and hence no need for reestablishing validity or reliability.

3.7.2 Internal Validity

Establishing a true causal relationship between the constructs such that cause and effect flow is properly differentiated ensures internal validity (Saunders et al., 2009; Yin, 2003). The data collection underpinned by the conceptual framework meets the context authenticity (Jabareen, 2009; Turner et al., 2017). A glossary of concepts of the framework in the data collection protocol (DCP) ensured that the problem is tractable without threatening internal validity. As suggested (Patton, 1990), any clarifications on the DCP questions from the respondents were replied to by email, and their revised responses were updated accordingly. Participants were given a copy of their responses for concurrence. By using a senior industry executive, the questions were designed such that the respondent differentiated between cause and effect. In addition, the merging of data from multiple respondents minimised the internal validity threats. The study ensured internal validity as follows. (i) The researcher being a software contract management professional and having programming experience able to: (a) develop the PRISM simulation routines, validate the same by experts and infer the results; (b) develop the data collection protocol and review the same with industry expert; (c) choose the set of relevant respondents through LinkedIn and follow up to receive the responses within time; (d) Use Nvivo to import data from google forms, perform text analysis and infer the results. The researcher attended a specialized workshop on Nvivo before performing the analysis. The experiments in PRISM and PRISM-games were repeated many times to verify the internal validity (Davis et al., 2007). The open-ended essay method reinforces the validity by drawing inferences from the responses of participants from multiple firms based on their experience and interpretation.

3.7.3 External Validity

Generalization of the results across settings which are different from what is chosen for the study, i.e. from lab to field, from small group to organization enhances general applicability (Saunders et al., 2009; Yin, 2003). The study addresses the external validity as follows. (i) Comparison of qualitative results against simulation results (Section 8.3) (Davis et al., 2007) for convergence, divergence and complementarity. (ii) Some respondents from non-IT service sectors were chosen

to improve the generalizability. (iii) The conceptual framework included literature from outcome-based contract literature from the equipment supply and services industry. (iv) Since the technology and delivery strategies of Indian firms address global markets and compete with international players, the generalizability of this study to firms operating outside India is high.

3.7.4 Reliability

The reliability test is to protect the study from errors and biases so that the instruments used are replicable and lead to the same result (Yin, 2003). The following activities were performed to improve reliability. (i) The simulation routine was reviewed by a post-doctoral scholar involved in the PRISM-games project team, and suggestions were incorporated for efficient execution. (ii) The data collection protocol used the same list of questions along with the same glossary of terms for all the participants. (iii) Use of Nvivo software for data analysis ensured that consistency was maintained throughout the study.

4. DATA ANALYSIS - QUANTITATIVE – MODEL CHECKING AND SIMULATION

4.1 INTRODUCTION

The simulation method is placed between theory creation by formal modelling and theory testing and has emerged as a popular theory development approach in the strategy literature (Davis et al., 2007). A simulation study is selected as the quantitative method since the OBC phenomenon suffers empirical limitations and the longitudinal nature of reputation (Kohtamäki et al., 2019; Rabetino et al., 2018; Selviaridis & Wynstra, 2015; Sjödin et al., 2019). Simulation ensures internal validity and its dynamic setting helps in raising novel theories from experimentation (Davis et al., 2007; McGrath, 1995). Simulation enables theory elaboration from formal modelling into a comprehensive theory which can be further tested empirically.

The reputation effect is modelled as repeated games and as a stochastic process (Halonen, 2002; Mailath & Samuelson, 2015). Concurrent stochastic games is a framework which adds stochasticity to repeated games (Basset et al., 2018; Kwiatkowska et al., 2020). The state is a variable, and state to state transition is controlled by a stochastic transition matrix determined by player's actions at each state. The CSG serves best in the OBC context of multiple players, multiple objectives, and uncertainty in the outcome. This probabilistic solution concept remedies the challenge of implementing the non-contractibility and marginal effects in the empirical study of PRT (Whinston, 2001). The CSG-based model can be verified by using model checking wherein the specification of the model and expected behaviour is checked for reliability (i.e., yielding consistent findings).

4.2 MODEL VARIABLES

The strategic interactions of two independent entities in an alliance contract can be represented as a stag-hunt game (henceforth, “the SHG”) (Parkhe, 1993; Santos et al., 2011; Skyrms, 2001). As

explained in Section 2.4.2, the payoff in SHG is designed to induce a player with R for mutual cooperation (MC) and T for unilateral defection (UD) such that $R > T > P > S$. Unilateral cooperation (UC) gets sucker's payoff of S and both parties defecting (MD) resulting in a punishment payoff of P. The firm theoretic concepts of opportunistic behaviour and asset specificity are mapped to UD and UC, respectively. The SHG formulation reflects the concepts in an OBC like co-production, equal and complementary investment, equal effect on the outcome and surplus sharing based on equality. A typical play of SHG by persons unknown to each other results in a non-cooperative hare-hunt(MD) equilibrium (Skyrms, 2001). The default non-cooperation result is consistent with integration as the last resort in PRT and TCE. The SHG implements inter-temporal concepts of reputation and adaptation in an environment wherein parties know each other with experience. The environment promotes non-random encounters where stag hunters can find other stag hunters which in turn induces hare hunters to adapt to stag hunters. Here, a cooperative stag-hunt (MC) equilibrium is realized. A production function can be expressed as a combination of risky, safe and intermediate actions, and there are implications if the actions are allocated to a combination of AI and human agents (Agrawal et al., 2018a).

This researcher extends the above literature to model an outcome-based contract. The realizable outcome through an OBC is treated as payoff R and the realized outcome prior to OBC as payoff T of a repeated SHG. The interaction of the parties to the OBC is modelled as a 2-player SHG. The distinct players are provider alliance and customer (e1). The provider alliance contains sp1 and sp2 as sub-players who own AA and DT, respectively. The customer e1 owns production/marketing assets.

A formal model is a representation of constructs in computational forms which are linked by a theoretical logic (Davis et al., 2007). The following Table 4.1 provides the list of model variables along with the measures. The player functions reflect the characteristics of assets owned.

Table 4.1
Constructs and measures.

Players	Description	Functional Form
Reputation for Automation assets	Bayes' law says precision is decreasing returns to data (increasing function, diminishing returns at higher levels of data,) (Farboodi et al., 2019; Farboodi & Veldkamp, 2021).	$p_1 = (1+y)^m \quad (1)$ $y \in [0,1]$ (investment level) $m > 0$ (prediction technology) for $y > 0$ $p_1(0) = 1$ = base level of prediction accuracy prior to OBC
Reputation for Digital transformation	p_2 is modelled as an exponential function which reflects its potential effect on productivity (Bertani et al., 2020).	$p_2 = e^x \quad (2)$ $x \in [0,1]$ (investment level in DT) $p_2(0) = 1$ = base level of DT prior to OBC
Marketing function of the customer	The final goods producer invests in production and marketing to improve its current knowledge about its business, assumed as linear. Improvement in knowledge raises the precision (probability weight) of the realizable outcome.	$P_3 = v * R_0 + (1-v) * T_0 \quad (3)$ $v \in [0,1]$ (investment to improve knowledge in actual quality and shift in consumer preference) R_0 = updated prior knowledge $p_3(0) = T_0$ = initial outcome prior to OBC and v is updated with realized outcome of the last period.

Outcome Production Function (T1): The transformation process, T1, evolves as independent and interaction effects of player functions, p1, p2, and p3, at each period until R1 (“target”) is reached, where $R1 \leq R_0$.

$$T_1 = \text{Max} [(p_1 + p_2)/2] * p_3, T_0 \quad (4)$$

The reputation of OBC Firm (O): Reputation literature represents reputation as a profit maximizer, level of quality, present value of future dividends, etc. (Board & Meyer-Ter-Vehn, 2013; Jovanovic, 2021; MacLeod, 2007). The reputation of the provider (OBC firm) is a measure which represents its ability to increase economic outcome at its customer business by investing y and x in AA and DT, while the customer invests v on production/marketing.

Reputation is modelled as a Fermi function:

$$O = [1 + e^{-\beta (T_t - T_0)}]^{-1} \quad (5)$$

where, T_t = realized outcome at each time-step because of verifiable investments x, y and v, $e = 2.718282$ and $\beta (0,1]$ reflects the customer reputation and other firm theory constructs. The Fermi function is a probability distribution with valid values between 0.5 and 1 (i.e., SHG payoffs, $T=0.5$ and $R=1$). It is calculated as the interaction effect of β , T_t and T_0 . The setting dictates that: (i) when $T_t = T_0$ (prior to OBC), $o=0.5$ irrespective of the value of β ; (ii) when $T_t > T_0$ (presence of OBC), the function acquires a value above 0.5, but limited by β . $T_t - T_0$ symbolizes the effect of investment. The reputation levels, $o=1$, o^* , and $o^\wedge$ are called perfect, optimal and tolerance respectively where $0 \leq o^\wedge < o^* \leq 1$. The contract terminates when reputation falls to $o^\wedge$, a switching point at which hybrid governance collapses and internalization occurs.

4.3 MODEL CHECKING AND SIMULATION PLATFORM

PRISM is a probabilistic model-checking platform developed by the Computer Science Department of Oxford University. PRISM-games is an extension of PRISM with features to model, verify, synthesize and simulate stochastic games (Kwiatkowska, 2016). This software platform features (i) r-PATL (reward-based Probabilistic Alternative-time Temporal Language), a programming to specify and query the player behaviour and game rules (Alur et al., 2002); (ii) Probability(P) and reward(R) operators use value iteration to compute precise approximations for optimal probability and expected payoff (Kwiatkowska et al., 2022);(iii) Markov chain based model checking and verification which offer internal validity in the problem representation and construct validity in accuracy of specification; and (iv) Experiments in discrete-event simulator to study the mechanism of player behaviour (Kwiatkowska et al., 2018, 2019, 2020). The CSG framework represents an abstraction of the OBC concept constructed in this study. As per the PRISM team, only Prism-games offers the facility to model the CSGs.

Outcome-based contract function representation in CSG:

$$G = (F, S, S_0, A, \delta, AP, L) \quad (6)$$

where $F = \{sp1, sp2, e1\}$ is the set of players with their action space $A = A_{sp1} \{(c_1, d_1)\} \times A_{sp2} \{(c_2, d_2)\} \times A_{e1} \{(c_3, d_3)\}$ over contract states $S = \{T1, r: [1..rounds] = \text{number of rounds}, y: [0..y_max], x: [0..x_max], v: [0..v_max], \}$, state transition probability $\delta : S \times A \rightarrow \text{Dist}(S)$ by using $\sigma = \text{tuple of strategies } \{[c1, c2, c3] \dots [d1, d2, d3]\}$ s.t σ^* is the strategy which maximizes the surplus (Social Welfare Nash Equilibrium (SWNE)). L is a set of labels for key states like “target” and “contract_end.”

Hardware and software for experimental environment

Software: Prism-games Ver 3.1, PRISM model checker Ver 4.7

Operating System: Ubuntu 20.04.4 LTS

Hardware: i7, 2.80GHZ CPU, with 32 GB RAM.

Default path length = 10,000

Confidence = 0.01

Simulation method = CI is used for verification of properties

Sample Size: 100,000

4.4 EXPERIMENT DESIGN AND MODEL DEVELOPMENT IN PRISM

PRISM provides statistical model-checking (henceforth, “the SMC”) and probabilistic model-checking (henceforth, “the PMC”) to verify properties through simulations (L’Yvonnet et al., 2021). Simulation is called a set of experiments in PRISM (Alharbi & Garlan, 2021). PRISM uses the following strategies in SMC and PMC to avoid large state space (called “state space explosion”) and consequent memory issues while verifying properties. The SMC utilises the discrete-event-based simulation engine to generate random paths of a large number for a finite count of steps (iterations) (PRISM_Manual, 2022; Seetanadi, 2021). The engine evaluates the result of the given properties on each step and guarantees an approximately correct behaviour of the system. The engine functions in the Confidence Interval (CI) method with a 99% confidence level (PRISM_Manual, 2022). The PMC is used for systems described in non-deterministic formalism such as concurrent stochastic games (finite horizon and step bounded). It checks the model for the existence of a path (strategy) to a target value (reachability property) within a finite number of steps. This study used 20 rounds as the maximum number of simulation steps in experiments to check for the behaviour of player functions and reachability for $T1=72$ when each player’s investment is varied in $\{0.01, \dots, 0.20\}$ range.

PRISM and PRISM-games use *reactive formalism* which defines its components as *players* or *interactive agents* who interact with each other as well as their environment (T. Chen & Lu, 2007). These interactions decide the behaviour of the system. Each component is constructed as “reactive modules (RM)”, a system description and modeling language (Alur & Henzinger, 1999; Henzinger et al., 1998). PRISM is a high-level modelling language which allows hierarchical and modular

description of systems. PRISM Model Checker verifies whether the behaviour of system components, alone or together, satisfies the reachability of objectives.

The following are the features of PRISM used in the development of the model for this study:

Model type: *Concurrent stochastic games*, a framework to model a dynamical system in a stochastic environment whose behaviour is controlled by concurrent player actions.

Modules: Each module contains variables and commands which describe players or sub-processes. The following are the modules used for this study:

The module *predicts* contains *variable* y of player $sp1$ to influence $p1$ (Reputation for Automation assets).

The module *digital* contains *variable* x of player $sp2$ to influence $p2$ (Reputation for Digital transformation).

The module *marketing* contains *variable* v of player $e1$ (customer) to influence $p3$ (Marketing function of the customer).

The module *rounds* contains *variable* r to set the number of rounds.

Action sets: each player controls a disjoint set of actions. Actions may also be state-specific.

The action sets are $\{c1(\text{invest}), d1(\text{defect})\}$, $\{c2(\text{invest}), d2(\text{defect})\}$ and $\{c3(\text{invest}), d3(\text{defect})\}$ respectively for the above three players.

Formulas and labels:

The formulae are implemented to compute equations (1) to (4).

“Contract_end” and “target” are the labels implemented to designate *reached states* at which path length completes r rounds/transitions and the outcome $T1$ reaches the realizable outcome $R1$.

Properties of the model:

Properties are the formal specification of the behaviour of the players in the model by using temporal logic. Properties are programmed in r-PATL). The *reward*

operator is used to implement the evolving reputation equation (5). Refer to Table 5 for rPATL-based property specifications used in this study and their results.

When an algorithm does not reflect real-world phenomenon or need, it is called *algorithmic bias* (Danks & London, 2017). It is a social concern. Researchers are influenced by their propensity or preference to overestimation of AI and underestimation of human capabilities (Kordzadeh & Ghasemaghaei, 2022). To avoid the algorithmic biases propounded in endogenous growth and technological change literature such as “scale wins” (Farboodi et al., 2019) or “reaching infinite values at a finite time” (Aghion et al., 2017), this study has chosen both AI-dominating automation and human-dominating digital transformation as complements in outcome production function by limiting their values at higher investment levels (Refer Fig.4.1).

4.5 FINDINGS

The initial tests are to check the consistency of the model with OBC literature. The corresponding R-PATL based temporal property specifications are given in Table. 4.2, indexed within round brackets. The associated player names are given in angle brackets. The players are separated by a comma if they are in a coalition and by a colon if they are individuals. The values of variables v , x and y range from 0.01 to 0.20. The targeted realizable outcome is set by using the label “target”= $T_1=R_1$, where the “target” is a named state at which $T_1=R_1$. The other values are: $R_1=72$, initial outcome $T_0=50$ which implies $O=1$ when $T_1=72$ and $T_0=50$. The results are presented below with numbers in parenthesis indicating a serial number of the PRISM properties as given in Table 4.2.

The expected investment of provider alliance $\langle sp1, sp2 \rangle$ which controls variables y and x in functions p_1 and p_2 , is verified as 10 units each totaling 20, and that of e_1 which controls v is 20 units (1 of Table 4.2). The expected surplus is 2 if strategic behaviour is absent. The marginal effect of investment by each party is verified as equal in moving T_1 to 60 from 50 (2). Hence, parties know ex-ante that inefficient investment below 10 units would yield an ex-post inefficient surplus. The probability of any party reaching its objective ahead by holding up the other is zero (3). The

target is reachable with certainty i.e., it is possible for them to collaborate by investing truthfully with probability 1 (4). The investment behaviour of parties and their effect on the outcome is shown in the following Fig 4.1.

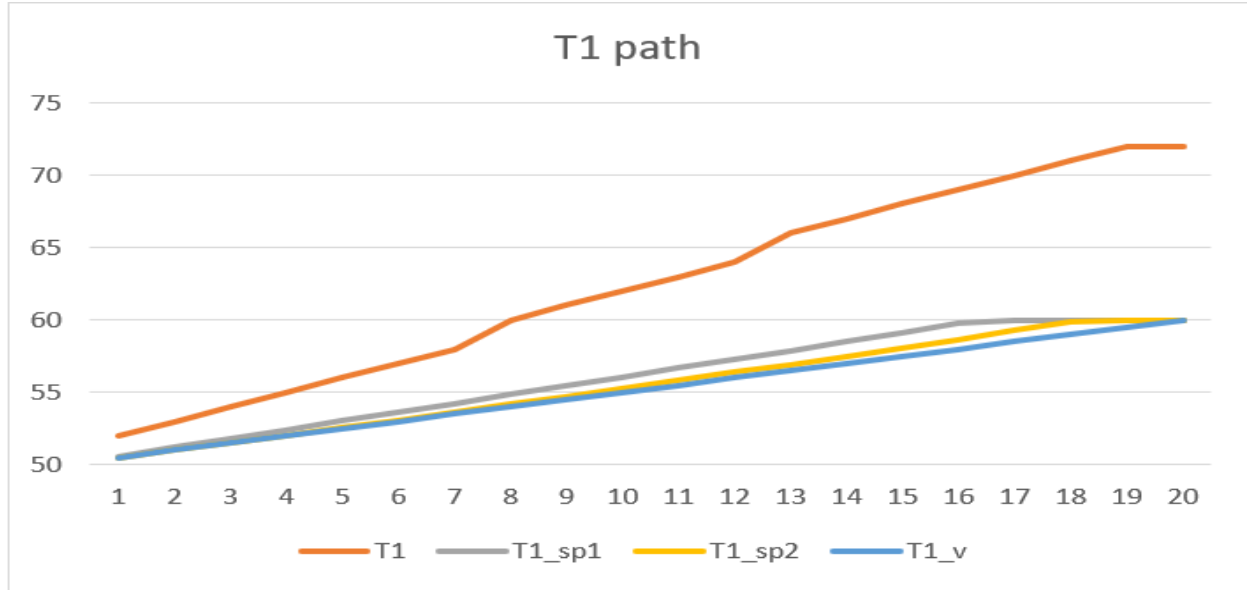


Fig. 4.1. Response of outcome (T1) to the as the primary and interaction effects of players' behaviour.

Model Checking for Proposition 1

The model checking computes provider reputation O when the provider alliance reaches the target in cooperation with the customer. Equation 5 reaches " O "= 1 for $\beta=1$, $T_1=72$ and $T_0= 50$. The property specification verifies these results as the interaction of player reputation functions (5), which confirms a path existence from T_0 to T_1 with certainty in 20 timesteps (r) is 20. This path existence supports Proposition 1 on the existence of provider reputation which substitutes interest of reputed customer in reaching the target. The OBC firm establishes and maintains its highest reputation when both parties behave truthfully as checked in the property specification (5). It shows that the probability of the reputation of OBC firm reaching its maximum is contingent both on its own investments ($[c1]$, $[c2]$), and that of customer $[c3]$. The state " $e1_cooperation$ "=20 shows customer investment is truthful. In that case, the first best is reachable (7). The joint outcome

reachability with total investment is certain (6). Players can recognize strategic behaviour (under-investment) by observing T1 and any retaliation brings down reputation to 0.5 as shown in Fig. 4.2 a, b.

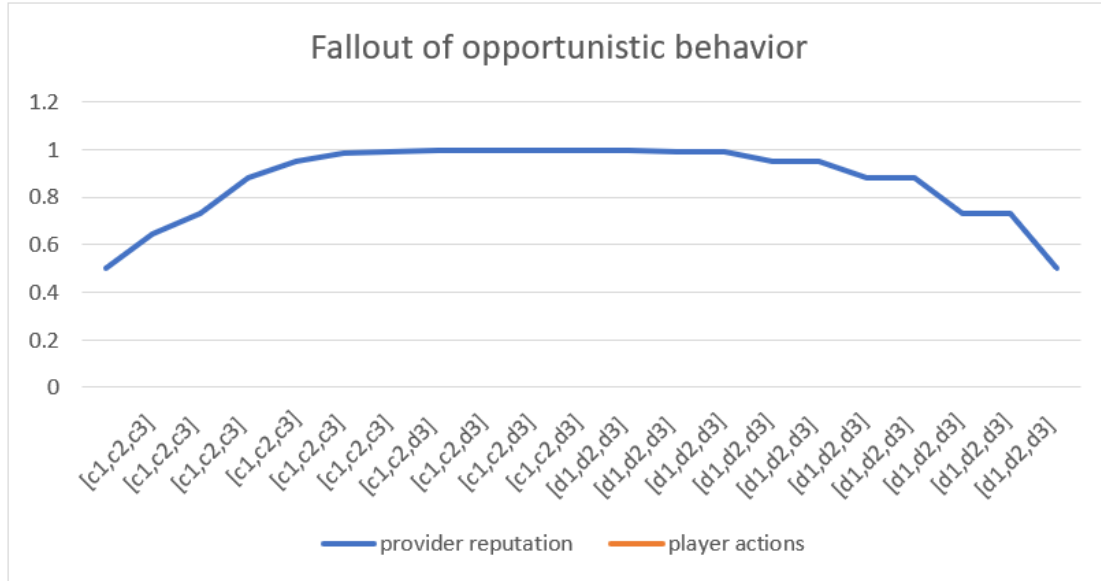


Fig. 4.2a. Model checking for Proposition 2

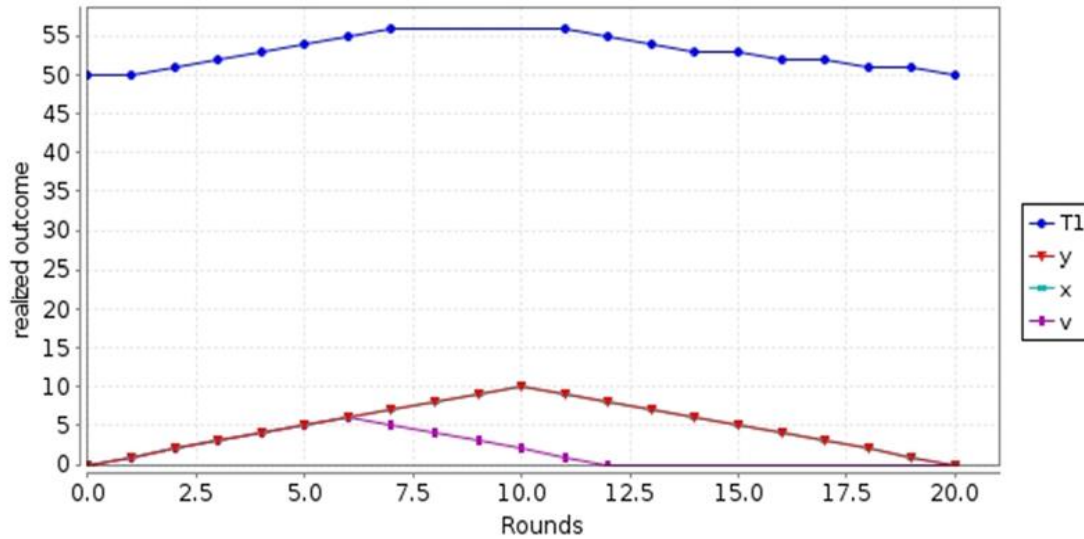


Fig. 4.2b. Model checking for Proposition 2

Table 4.2

Model checking by rPATL-based property specification and their results.

S. No	Property	Result
1	$\llsp1\gg R\{ "sp1_cost" \} \max = ? [F \text{ "contract_end"}]$ $\llsp2\gg R\{ "sp2_cost" \} \max = ? [F \text{ "contract_end"}]$ $\ll e1 \gg R\{ "e1_cost" \} \max = ? [F \text{ "contract_end"}]$ $\llsp1, sp2\gg R\{ "sp1_sp2_cost" \} \max = ? [F \text{ "contract_end"}]$ $\llsp1, sp2: e1\gg \max = ? (R\{ "sp1_sp2_cost" \} [F \text{ "contract_end"}] + R\{ "e1_cost" \} [F \text{ "contract_end"}])$	3.9999999999990687 6.0 10.0 9.99999999999998 20.0
2.	filter (max, T1, v=v_max&x=0&y=0) $\ll e1 \gg P \max = ? [F \text{ T1}=60]$ $\ll e1 \gg P \max = ? [F \text{ T1} \geq 60]$ filter (max, T1, v=0&x=x_max&y=y_max)	60 1.0 0.0 60.0
3.	$\llsp1\gg P \max = ? [\text{ T1_p1}=\text{ T1_sp U rounds} < 20]$ $\llsp2\gg P \max = ? [\text{ T1_p2}=\text{ T1_sp U rounds} < 20]$ $\ll e1 \gg P \max = ? [\text{ T1}=60 \text{ U rounds} < 20]$	0.0 0.0 0.0
4.	$\llsp1, sp2: e1\gg \max = ? (P [F \text{ T1}=72 \& \text{ "contract_end"}] + (P [F \text{ T1}=72 \& \text{ "contract_end"}]))$	2.0
5.	filter (max, r, "target") Model constants: x_ini=1,v_ini=1,y_max=20,x_max=20,v_max=20,beta=1,sp1=0,sp2=0,rounds=20) "O_Reputation": $\llsp1, sp2\gg R\{ "O" \} \min = ? [I=21]$ "p3_cooperation": $\ll e1 \gg R\{ "e1_c" \} \min = ? [F \text{ v}=\text{v_max}]$ $\ll e1 \gg P \max = ? [F \text{ "p3_cooperation"}=20]$ $\llsp1, sp2\gg P \max = ? [F \text{ "O_Reputation"} > 0.999]$	20.0 0.999954602132 20 1.0 1.0
6.	"First_best_outcome": $\llsp1, sp2: e1\gg \max = ? (P [F \text{ "target"} \& \text{x}=\text{x_max} \& \text{y}=\text{y_max}] + P [F \text{ "target"} \& \text{v}=\text{v_max}])$	2.0 (1.0,1.0)
7.	"First_best_surplus": filter (max, T1, v=v_max&x=x_max&y=y_max)+ $\llsp1, sp2: e1\gg \min = ? (R\{ "sp1_sp2_cost" \} [F \text{ "target"}] + R\{ "e1_cost" \} [F \text{ "target"}]) - T0$	2.0 (-10.0, -10.0)
8.	The following two properties show that neither p1 nor p2 can influence the outcome on their own. The result remains nearly the same if y invests 6 when x invests 5. filter (avg, T1, x=5&y=5&v=5) filter (avg, T1, x=5&y=6&v=5) The following property shows that outcome moves up in lockstep with investments by all proving their complementarity: filter (avg, T1, x=6&y=6&v=6)	54.95744680851064 54.97826086956522 55.95454545454545

9.	filter (min, y, T1_p1=T1_sp)	17
	filter (min, x, T1_p2=T1_sp)	19
	<<sp1>>R{"sp1_cost"} min=? [F T1_p1=T1_sp]	3.4
	<<sp2>>R{"sp2_cost"} min=? [F T1_p2=T1_sp]	5.7
	T1_sp1 is the target reached by the provider by truthful investment. The cost for sp1 is lower than that of sp2.	

Model Checking for Proposition 2

Proposition 2 investigates the interaction of player functions from complementarity and substitutability perspectives. Reinforcement effect of provider alliance, p_1 and p_2 are implemented as an average of their individual functions $(p_1+p_2)/2$ (same result prevails by square rooting p_1*p_2 as $p_1(0) = p_2(0) = 1$). The functional forms are such that the response of T1 is contingent on investment by all parties. Complementarity existence is verified and results in (8) supporting the logic which led to Proposition 2 that the outcome-based contracts require equal investments, equal effects on the surplus, equal outside options, and equal shares in the surplus. The equal outside option is protected by joint ownership with veto rights.

Model-checking for Proposition 3

The incentive to invest in the reputation of AA decreases in the reputation of DT once AA's full influence over the outcome is achieved. In the model, it happens for the investment level $y = 17$. However, AA is cheap due to its capital nature. The investment level x on DT is costly because of its labour nature (Acemoglu & Restrepo, 2018b; Agrawal et al., 2018a). Therefore, the incentive is dulled for investments in DT compared to AA. Investing in AA and making its proportion larger is comparatively efficient. It is verified in (9), where $T1_sp=60$ is the OBC firm's individual objective. Thus, the model does not support Proposition 3 that the reputation of digital transformation dominates.

Model Checking for Proposition 3 and the effect of asset transfer

The actions [c12] and [c21] represent the effect of loss of control by the customer and gain of control by the OBC firm. Productivity improvement offered by these actions is represented as cost reduction weighted by probability to reflect the stochasticity (uncertainty) in player behaviour and exogenous shocks which distorts the effectiveness of allocation. The assignment of ownership rights to the OBC firm shows up as productivity improvement only at high probability weights. However, if the contract task list is assumed to be fixed, then [c12] shrinks the task list under DT. Thus, the y and x variables are mutually reinforcing under the asset transfer case. The automation assets eventually dominate the outcome production with a fall in the unit cost of the outcome. The above suggests that Proposition 3(i) is supported in cases where the task list is not fixed. Proposition 3(ii) is supported only when the assignment of ownership to the OBC firm is present. Both reputations are equally incentivized, and they are complements. The cost advantage edges up AA, and diminishing returns expected at a high level of precision may erode that advantage (Farboodi et al., 2019). However, for the fixed task list, with a larger proportion of tasks being substituted by AA, substitutability dominates while complementarity wanes. Under these conditions, the incentive to invest in marketing by the customer becomes significant if AA and DT are under independent ownership and they compete to access the assets of the customer. This result is consistent with the 3-assets model of Hart & Moore (1990), p 1148. The reputation of automation assets dominates as the scale is expected to win eventually (Farboodi et al., 2019).

Model checking for Proposition 4

The term β in Equation (5) represents the reputation of the customer. The congruence of the reputation of parties is one of the characteristics of the OBCs. The reputation level O of the provider rises in time, β and investments. The reputation level rises faster at a high level of β which means the OBC firm achieves its highest reputation while it is in contract with customers of similar reputation (Fig. 4.3a). The higher the reputation of a customer, the faster the OBC firm establishes a high level of reputation (Fig. 4.3b). For customers of intermediate levels of reputation, the reputation gain takes a longer time. The OBC firm reaches the perfect reputation level of $o=1$ in a

shorter time for high β and a longer time for low β (Fig. 4.3c). The effect of inter-firm reputation on the cost of investment of the provider is shown (Fig. 4.3d). The OBC firm needs higher investment to build a reputation while contracting with low-reputed customers. The cost of reputation rises at lower levels of β and stabilizes at $\beta=0.7$. It is optimal to contract with customers at this level. The above analysis concludes that the reputation of the parties to an OBC affects in the same direction and supports Proposition 4.

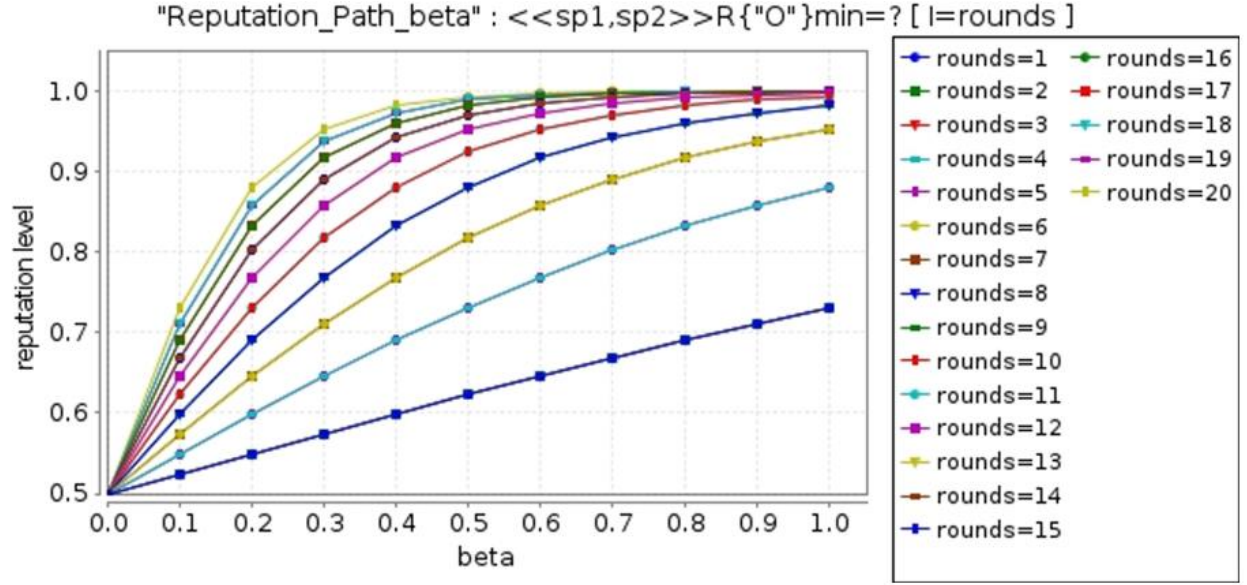


Fig. 4.3a. Model checking for Proposition 4

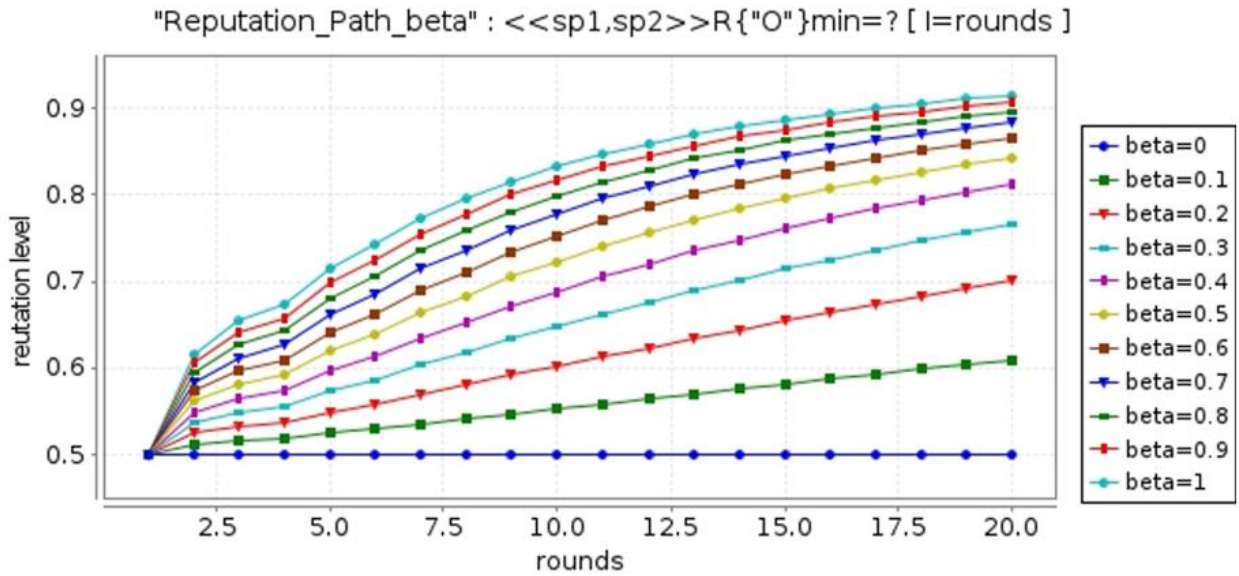


Fig. 4.3b. Model checking for Proposition 4

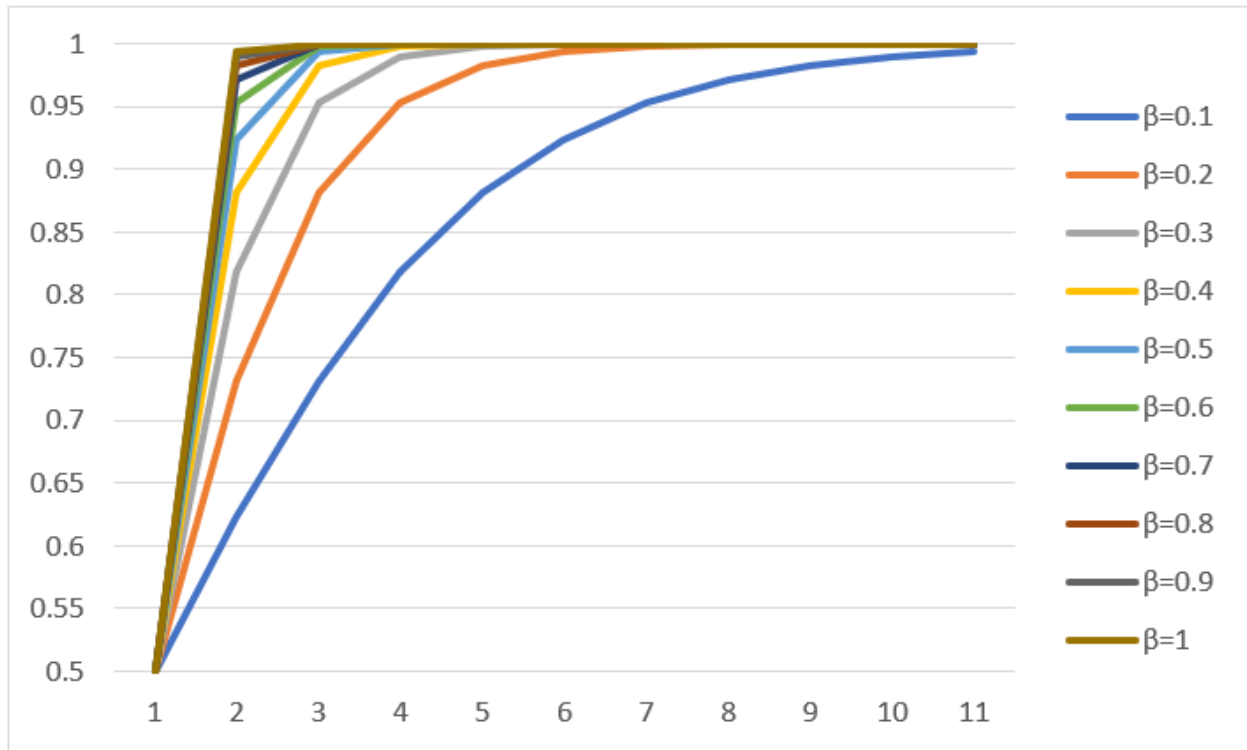


Fig. 4.3c. Model checking for Proposition 4

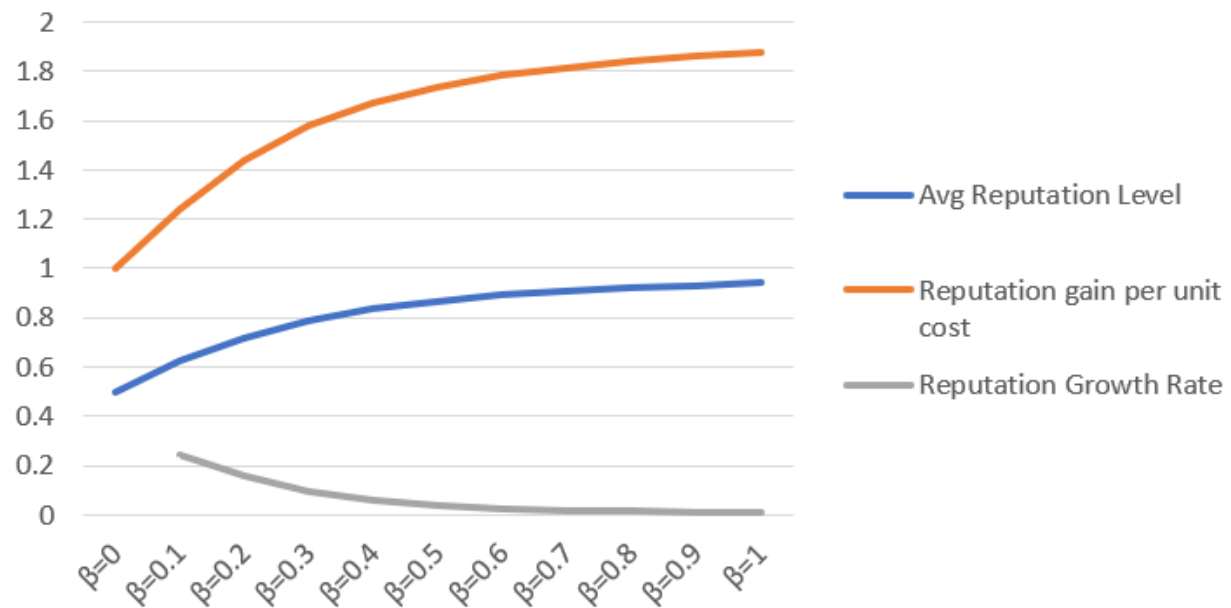


Fig. 4.3d. Model checking for Proposition 4.

Summarised Findings

Table 4.3

Summarised findings from quantitative study.

Propositions	Findings from Quantitative Study
<i>Proposition 1 (P1): For a provider with ownership of AA and DT assets, there exists a reputation level $\alpha^* \in (0, 1]$ at which the provider is a substitute to its customer in providing OBC services.</i>	The interaction effect of player functions is verified by property specification which confirms the existence of a path to the first best. They can collaborate with probability 1 when the game completes at $r=20$. The existence of this path supports Proposition 1. The provider could use its reputation built from ex-ante and ex-post efficiency improving technology assets to induce efficient investment by customers to produce the first best outcome.
<i>Proposition 2 (P2): Joint ownership of complementary assets with veto rights is the most appropriate structure for OBC transactions.</i>	Interaction of functions shows outcome (T1) is responsive only if all parties invest. AA and DT are complements. They are in turn complement customer assets. The existence of complementarity is verified in the model checker, and results (9) support the arguments. It shows that OBC requires equal investments for an equal effect on the surplus (symmetric dependence). It requires joint ownership with veto rights as safeguards with equal outside options and equal shares in the surplus.
<i>Proposition 3: Intra-firm reputation interaction at service provider (P-3):(i)Investment incentive to AA as general reputation decreases in DT as specific reputation. (ii) Any rise in one of the reputations counters the fall in other reputations and vice versa.</i>	Investment incentive to the reputation of the AA is limited by its influencing level in terms of prediction precision. DT should naturally take over the incentive preference. However, automation is cheap due to its capital nature and DT is costly due to its labour nature (Acemoglu & Restrepo, 2018b; Agrawal et al., 2018a). Therefore, the incentive is muted for DT eventually. It is efficient to invest in AA and make its proportion larger in the outcome production function. It is verified by model checking shown in (10), where $T1_sp=60$ is the individual objective of the OBC firm. Hence, Proposition 3 that the reputation of DT dominates is not supported. The transfer of incremental assets to the services provider is implemented as a probability-weighted cost reduction in the simulation. Results show that productivity improvement happens only at high probability levels. For a fixed task list, the task list available under AA shrinks as the contract evolves via mutual reinforcement between two assets. Automation assets become dominant eventually in the outcome production with the unit cost of outcome falling. A fixed task list does not support Proposition 3(i). It is supported if the task list is not fixed in which relevance for DT is sustained. Proposition 3(ii) is supported only when asset transfer to the provider is present. The above results show that both reputations have equal incentives and mutually reinforcing showing complementarity.

<i>Proposition 4: (P4):(i) Inter-firm reputations affect performance of outcome-based contracts in the same direction. (ii) Outcome-based contract transfers reputations such that higher the reputation of the customer, the higher the reputation of the provider.</i>	The customer's reputation is β in Equation (5). Reputation level O rises in time and β, accelerates at high β, i.e., OBC firm achieves reputation faster in a contract with customers of higher reputation. Else, it takes longer. It stabilizes at intermediate customer reputation. 4(i), 4(ii) are supported. Hence, the reputation of the customer affects the reputation of the OBC firm in the same direction.
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5. DATA ANALYSIS – OPEN-ENDED ESSAY QUESTIONS

5.1 INTRODUCTION

By underpinning our qualitative research on a conceptual framework, we follow the recommendation of Creswell (2003, p. 133) that states “no qualitative study begins from pure observation and that prior conceptual structure composed of theory and method provides the starting point”. This approach is deductive in nature as we test/verify the propositions through the participants’ responses. By generating the questions in the DCP from the propositions of a conceptual framework, the researcher adhered to Creswell’s prescription. The intention is to uncover the participants’ construction of the phenomenon by analysing all the responses (Rule & John, 2015). Thus, the study implements Mill’s observation that reasoning by deduction to the extent possible needs a follow-up of conclusions from observations, and revision of premises if found logically credible (Mill, 1889). The economic laws are approximate in character and require empirical corrections for applicability. Conclusive deduction and exhaustive induction are impossible (Knight, H, 1957; Mill, 1889). Thus, in a qualitative study, the objective is to discover evidence from data that supports or refutes the propositions derived from a conceptual framework. Thus, it is a deductive process with theory verification as a purpose. This section presents techniques used in collecting and analyzing empirical data.

A qualitative *open-ended essay method* of a narrative form is used as our research method. This method is popular in social and management research for experiential assessment as it provides rich insights (Bennion et al., 2020; Chaudhary et al., 2022). This method supports researchers since the work-from-home (WFH) mode renders contact-based research methodologies like case studies infeasible. This narrative method enables drawing inferences from the responses of practitioners based on their experience, interpretation, perception, and priorities. It reinforces the validity.

5.2 DATA COLLECTION PROTOCOL

The open-ended essay-based questions was prepared in Google Forms (Refer to Annexure 1). The questions were prepared with conceptual framework-based terms/codes that were explained in a glossary given as a preface in the DCP. These terms act as the “knobs’ and “off-the-shelf” coding schedules as recommended in research method literature (Saunders et al., 2009). They are used as "alphabetical prompting" which is found to improve the efficiency of open-ended questions (Weller et al., 2018). The standard business terms such as pre-sales, contract finalization, contract execution, and contract closure are preferred instead of literature-based terminologies of ex-ante/ex-post contract stages. The questions included phrases such as “kindly explain,” “kindly describe,” “other factors,” and “any other” so that the respondents choose an open-ended narrative form of response. The codes represent the theoretical concepts – ownership structure (control structure and incentive structure), reputation and technology (Refer to Table 5.2 and Fig. 5.1a,b). This approach ensured that respondent data aligned with the theory-based codes maintained the consistency of the code, and protected data collection against drift during the study. This approach increases analytical rigour and leaves less room for interpretation. This ensured replicability yielding similar results (Yin, 2003). The link to the self-administered data collection protocol was emailed stating the purpose of the exercise. A telephone conversation informed about the study and its purpose before sending the link. All the queries and clarifications on the questions were given by email or phone, and clarified data was incorporated for analysis. The respondents were shared with their incorporated responses as acknowledgement.

5.3 SELECTION OF RESPONDENTS

The following are the inclusion/ exclusion criteria to select respondents:

Inclusion criteria:

- Participants must be contract management professionals of technology firms.
- The firms must supply technology services that are inputs to final goods/services firms.
- The participants must be in decision-making or strategic roles.

Exclusion criteria:

- Those who do not have exposure to the OBCs are excluded. The first question in the DCP acted as the filter: (1)Do you have experience in offering managed services contracts? (2) Are you aware of Outcome-based contracts?
- Those who are not in decision-making roles

The following gives the statistics of the participants' enrollment:

Total Invites sent:	60
Responses Received:	36
Rejected Responses:	3
Total Analysed:	33 (data saturation achieved at 30)

Participants' names and affiliations were kept anonymous and confidential. The researcher is the only one given access to the full data from respondents. The questions were prepared and refined along with one respondent at the level of CEO of a multi-national technology firm. The DCP was pretested with a respondent from another firm. The following table gives the participant profiles.

Table 5.1

Participant profiles of the open-ended essay questions method.

P Code	Position	Type of firm	P Code	Position	Type of firm
P1	Manager	Mfg	P18	CEO	Fintech
P2	Owner/Partner owner	Mfg	P19	Owner/Partner owner	Mfg
P3	Owner/Partner owner	Mfg	P20	Owner/Partner owner	Mfg
P4	Manager	Mfg	P21	CEO	Healthcare

P5	Director	Mfg	P22	Owner/Partner owner	Mfg
P6	Director	Fintech	P23	Director	Mfg
P7	Director	Mfg	P24	Director	Cloud & telecom
P8	Director	Cloud & telecom	P25	Owner/Partner owner	Mfg
P9	CEO (4)	Mfg	P26	Manager	Mfg
P10	Owner/Partner owner	Mfg	P27	Director	Mfg
P11	Director	Mfg	P28	Owner/Partner owner	Mfg
P12	Director	Mfg	P29	Owner/Partner owner	Mfg
P13	Director	Cloud & telecom	P30	Director	Mfg
P14	Director	Fintech	P31	Director	Healthcare
P15	Director	Fintech	P32	Director	Healthcare
P16	CEO	Fintech	P33	Manager	Mfg
P17	Manager	Fintech			

5.4 CONCEPTUAL MODEL AND DATA STRUCTURE

The qualitative study used the main concepts of the conceptual model for data collection (Fig. 5.1a). The data collection protocol used five themes to provoke respondents (Fig. 5.1b). The definitions of the themes used as part of the data collection protocol are given in Table 5.2.

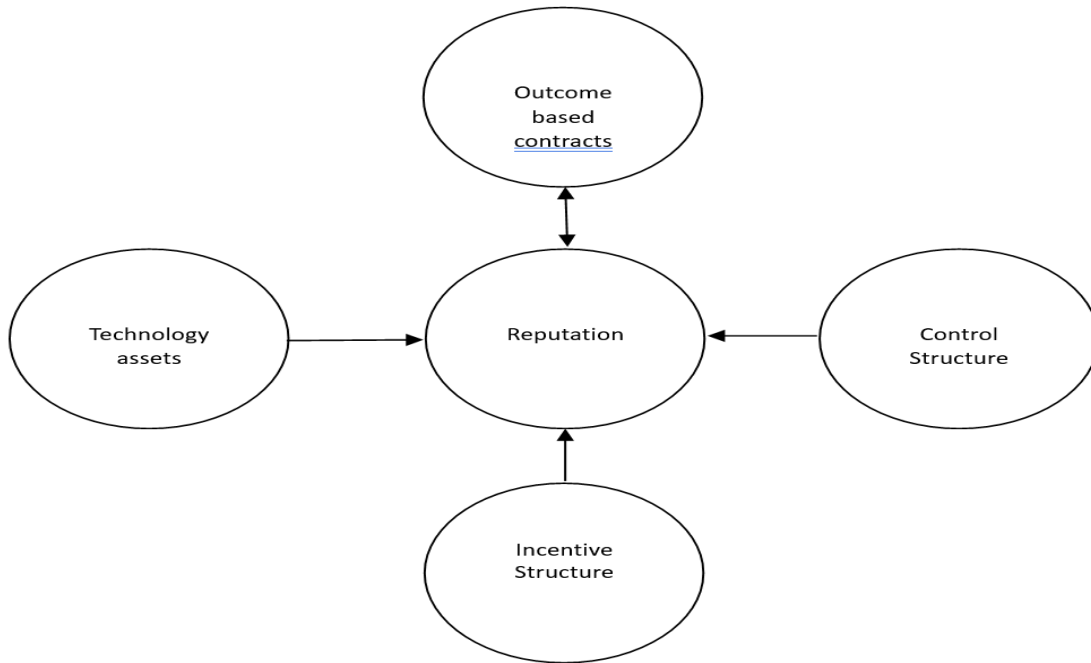


Fig. 5.1a Conceptual Model for qualitative analysis.

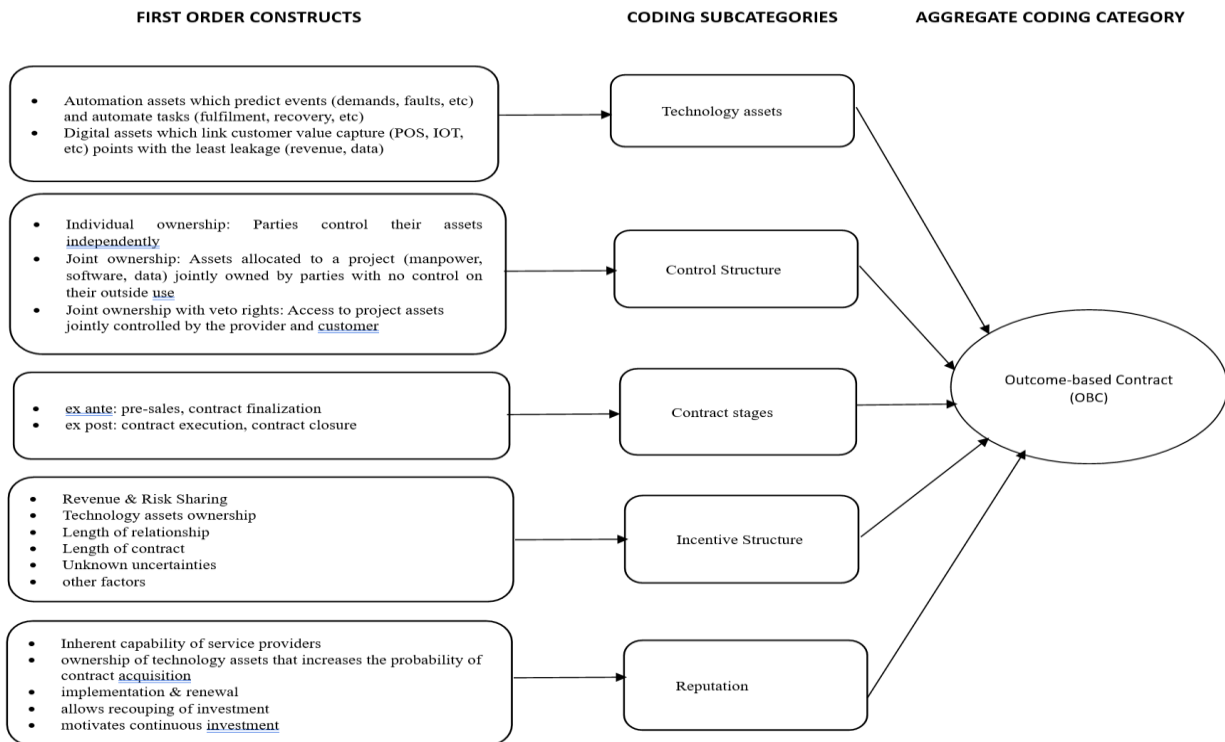


Fig 5.1b. Data structure for qualitative analysis.

Table 5.2
Definition of the constructs

Construct	Definition
Technology assets (Williamson, 2002)	Productive resources which generate certain value for customers. Assets are developed for specific customers (specific investment) or general customers (general investment). The value for the first falls outside the relationship. Assets contribute to minimizing transaction costs, uncertainties, and investment inefficiencies.
Control structure (Ownership structure (Hart & Moore, 1990))	Ownership rights offer residual rights over assets which can be leveraged by the owner. There are independent or joint ownership. An efficient ownership structure preserves the value of the asset (Williamson, 2002).
Contract stages (Hart, 1989)	<i>Ex-ante</i> is associated with pre-contract or initial contract stages wherein specific investments are not made. The <i>ex-post</i> stage is associated with all actions once the states of a contracted anticipated or unanticipated are realized. Automation and digital transformation are efficient in supporting ex-ante and ex-post respectively (Shanmugam & Dhingra, 2023).
Incentive Structure	Incentives are the <i>sources of inducement</i> to invest as a function of <i>revenue & risk Sharing, technology assets ownership, length of relationship with the focal customer, and length of contract</i> . The length of relationship and length of the contract also lead to reputation.
Reputation	Reputation is <i>general at the corporate level and specific at the product level</i> (Chandler, Polidoro, & Yang, 2020). Influences contract performance at the time dimension

5.5 FINDINGS

This section provides the questions that were raised in the data collection protocol, the reason for raising those questions and presents the responses received from the participants.

5.5.1 aOBC – empirical definition

Q1. Do you have experience in offering managed services contracts? What are the main capabilities expected for such contracts? Kindly explain.

The above question was raised to evaluate whether the participants identified the first type of OBC – the availability-based outcome (aOBC). An aOBC is alternatively called in the industry as a managed services contract (MSC). The following are the responses with the participant code given in parentheses.

The scope of the aOBCs is to provide routine or low-level support services to software applications or platforms in production at a predefined service level (P1) and predefined price level (P4, P2, P1, P3). The performance measures are sought by the product user team on the customer side (P18). The main objectives are cost optimization, adherence to service level for schedule, effort, and quality specification (P6). The productive assets and capabilities to enable aOBCs are continuous improvement in reliability, robustness, prognostics, continuous stakeholder management, mutual trust, and contract forbearance (P5, P9, P13, P25). Many participants mentioned tools for outcome measurability, experience and expertise, product ownership and support as the key requirement. The other capabilities are the ability to scale up and transition fast, communication backbone, long-term commitment and accountability, risk measurability, and understanding the behaviour of customer's customer (P18). The challenge is to build larger capabilities at lower cost, and use of resources by balancing the cost and commitment (P29, P31).

5.5.2 Outcome-based contracts – empirical definition

Q2. Are you aware of Outcome-based contracts? Kindly explain their distinct features you noted against traditional contracts.

The above question ascertained whether participants were aware of the distinction an OBC makes based on the economic benefit delivered. Participants perceive outcome-based contracts as ones in which provider revenues are partially as low fixed fees or completely tied to the agreed cost or revenue stream of the customer's operations. These contracts are concerned with performance measures sought by business users (P18). These contracts are not linked to milestones, deliverables, and efforts. They are flexible, less specific and with more grey areas, incentivize upsides and penalize downsides with risk-reward sharing, and encourage innovation. The customer

intends to avoid capital expenses, protect existing outcomes on the customer side, improve market share and avoid too many levels of subcontracts (P2, P10, P11, P18, P8, P25). They become particularly relevant when a customer faces demand or economic uncertainty so that providers assure delivery and price certainty. These contracts suit such win-win situations (P26, P29). They offer higher risk and return and aim for a complete overhaul, and not incremental improvement (P3, P4). They require technologies which are mature or in which customer lacks knowledge (P3, P13, P14). They sometimes face contract closure challenges like ownership of tools and other assets created which was not directly done for the customer's explicit request (P18). The legal terms are tied to outcomes (P13). They require upfront investments by both parties (P32). Many participants mentioned that tools for measurements, ownership of products and outcome attributability devices as important productive assets. Other tools are data monetization, and story points that add value to customers and raise accountability (P3, P12, P14, P15). Most participants believe overcoming uncertainties and minimizing ambiguity in which providers have no control is very critical for success. Participants prefer to use mutual trust, domain knowledge and long-term engagement as coping mechanisms.

5.5.3 Investment behaviour in traditional contracts

Q3. Given any contract, do providers prefer to invest in: (A) internal development of technologies, (B) 3rd party licenses? Kindly describe situations where you prefer (A) or (B).

Question no. 3 is to take stock of the investment decisions in the traditional contracts. The decision of the customer to buy or make depends upon his capital or procurement strategy and cost-benefit analysis. Every customer situation is different (P16). The customer decision rule considers the total cost of ownership, provider capability to support, customer capability to pay, product maturity, and time to market (P20, P24). The preference to make internally dominates whenever customer demands high asset specificity, long-term control, and flexibility in the form of property rights, lock-in avoidance and when 3rd party products insufficiently meet the requirements. The “make” option is preferred if it offers the provider a quick market share, utilization of bench staff, acceptable return on investment, transferable investment, and future market potential (P4, P30,

P18, P19). Internal development also depends on the availability of skills and whether the asset falls within his core business, nascency of technology and perceived future competitive advantage (P17, P25, P10). Internal development is mandatory for customers such as defence who demand asset blueprints and unique requirements (P25). A core business which requires innovative solutions/offerings and perhaps a good candidate for internal development. Such a solution might take the market by storm and take a good pie of the market (P4). Internal development is also a talent retention tool (P32).

Providers choose the buy option if the customer prefers well-established 3rd party products at the enterprise level since they are risky and costly to make, quick to market, off-the-shelf and cheaper to leverage. The buy option is also preferred when the technology is not a core business. The buy option minimizes human specificity and maximizes scalability within an agreed timeline (P13, P14). Large enterprise customers prefer readily available industry-standard products (P25). Providers opt for rental, cloud, and subscription models if minimal features of a technology asset are sufficient to meet the customer requirement (P28).

Technology platformization and 3rd party agreements determine the make-or-buy decision (P33).

5.5.4 Incentive Structures in the OBCs

Q4. In an OBC, which factor(s) should influence the investment decisions of providers: (A) Revenue & Risk Sharing, (B) Technology assets ownership, (C) Length of relationship, (D) Length of contract, (E) Unknown uncertainties, (F) other factors you know? Kindly explain your choice(s).

Based on the incentives to invest found in theories of the firms, the above question ascertained which factor dominates provider decisions. The following provides the influences of these factors as found in the responses.

Revenue & Risk sharing (RRS) influences the most since it offers the opportunity to the provider to reap a reward commensurate to the risk as a safeguard. Though the process is similar to any other investment decision, the OBC shall align with the risk profile of the provider by giving visibility into total contract value, impact on P&L and other liabilities (P2, P7). A fair understanding and alignment on revenue and risk sharing should be established ex ante (P14). The critical issue for decision-making is the question of what level of technology assets to develop (P10) in the OBC environment of risk aversion, uncertain returns, unmeasurable outcomes, and new products with slow technological progress (P11). Hence, many participants expect a reservation utility as a fixed fee to cover the risk and other mitigation measures. As the project progresses, the certainty of achieving the desired outcome increases along with better information symmetry and trust in cooperative actions, the RRS structure should evolve to reflect a mutually beneficial arrangement (P14). RRS suits projects where the provider could determine the price to be quoted with high confidence on the contingencies with the help of AI, favourable exogenous market events, and competition (P29). RRS will make sense only for a new product being developed and its revenue stream can be measured clearly by the provider, even if not predicted. But that is unlikely (P18).

Technology assets ownership gives providers an outside option with the income/ residual rights over the code and other productive assets that are common parts of the solution supplied with specific parts owned by the customer (P10, P13). Ownership induces efficient cost-saving investments and provides control rights over future revenue streams (P9). The potential of AI and knowledge acquired therein from a customer is a big learning-by-doing attraction compared to traditional tools development opportunities (P18). This is particularly true when product license costs are high, and clients depend on upgrades which give recurring income rights to the provider (P23, P25). Property rights is a contentious part and always have exit criteria attached for the customers (P32). Ability to keep contracting tight and change order mechanism in place for managing uncertainties - that includes appropriate and detailed documentation at the time of contracting.

Length of the relationship and length of the contract allows the provider to gain insights from private learning about the customer and his culture, a deep understanding of his unstated facts, his environment and other information which can be used to anticipate contingencies and determine adaptation needs. This, in turn, helps the provider with better decision-making in investment, better risk-taking, and assess time requirements for recouping the investment (P13, 32). The payback period should not be beyond 4-6 quarters (P2). It is a clear trust factor which leads to reciprocity and information sharing. Providers would not like to lose any prestigious client due to reputational incentives and these investments are considered worth the price to pay for (P18). The OBCs take time for the lock-in effect to set in and start showing the results, and the initial years will not yield positive returns. The relationship strength increases bilateral dependency which will help to overcome short-term challenges (P22). The potential for long-term relationships in the form of repeat contracts influences investment levels. A strong and ongoing relationship may motivate providers to invest more in technologies to ensure continued success. Short-term contracts may lead to more cautious investment decisions (P24).

Unknown uncertainty: Sometimes innovations and distributive models change the entire course of the business or providers run out of business (P28). Endogenous factors such as the disconnect between Sr Leadership / Procurement teams that negotiate the contract and the second/third line teams that work with the Partners – the disconnect could make/break the contract and assumptions around it (P32).

5.5.5 Influence of Ownership allocation in incentive structure

Q5. In an OBC, shall the assignment of ownership of technologies/software developed to the provider is essential to induce investment? (A) Highly critical, (B) Critical, (C) Not required? Kindly explain.

The participants revealed that allocation of ownership is a significant factor in their investment decisions in outcome-based contracting. The allocation to the provider encourages an ownership view of the problem, imbibes the intention for a longer relationship, induces to meet the best interest of the customer by making efficient (cost-saving or value-increasing) investments, good

upkeep of the products and discourages temporary solutions. Not allocating the property rights would dull the incentives since the provider may not be able to capture income rights within the contract. The participants treat the allocation as the most critical aspect of the contract (P10). Allocating complete or partial property rights and income rights from future IP proceeds is very critical for the supplier to invest in (P13). It helps the solution to evolve and complement the customers' production environment thus playing a long-term role (P14). It is a typical ask from the provider's perspective since this is the only residual gain in case the outcome is not fully delivered (P20). An incremental visibility of the outcome helps induce investment. If the solution is expected in cycles, successful implementation of the first couple of cycles sets the tone for overall engagement (P4).

Since the product is developed by the provider and is dependent on him for maintenance and upgrades, the marginal value of the provider's investment is more critical than that of the customer. Hence, it is efficient that the provider controls the asset. The investment is only to the extent of what a provider can control for ownership (P1, P29). The greater the future value, the broader the market space, and the larger the potential ROI, the more critical the ownership. In the absence of outside value, the provider may not be interested in holding and maintaining these assets on a long-term basis (P16). The discussion on ownership does not matter in an OBC since the customer looks for the outcome, not the technologies/products (P11, P24). Service manufacturers such as banking and healthcare would require joint ownership while others are not particular at all (P5). If ownership is denied, service providers can transfer the knowledge acquired and meet another situation (P9).

5.5.6 Preferences in Ownership Structure

Q6. In an OBC, kindly choose the preferred ownership of project assets (software, data) between the provider and the customer: (A) Individual ownership, (B) Joint ownership, (C) Joint ownership with veto rights, (D) Any other model you know. Kindly explain the influence of choice(s) in investment decisions.

This question evaluates the choice of ownership that best influences the provider's investment in the OBCs.

(A) *Individual/independent ownership*: Participants prefer individual ownership of the software platform to the provider and data to the customers since the parties are independent entities. Though the preferred option is the common ownership of the platform and data whose joint value is higher, both parties will vie to keep them under individual ownership (P21, P24, P27). Individual ownership gives freedom and flexibility to control the assets and provides income rights/residual value to the provider for the long term. There are very few cases where data is shared (P13). Customers should own the data since data is considered the new oil, and providers are not mature enough to handle data in the context of data regulation, and hence the joint ownership of data is not advocated (P13, P18). Customers will insist on keeping ownership of the asset if they are paying for the inputs and the provider is only providing the services (P16). Customers will want to legally own the IP that is created jointly to maintain the perceived competitive advantage (P5). The onset of cloud technologies has redefined the concept of ownership. There is no ownership in platforms except access rights (P13). Individual ownership of AI model does not mean that the model will have the same success rate in an environment for which it has not been trained yet, however, it should remain with the provider (P14).

(B) *Joint ownership with no veto*: Using the assets for outside opportunities will induce both parties to give their 100% to reap the benefits of outside options and surplus sharing in the realized outcome if parties are patient and willing to bear sunk investments (P1, P24). From a client perspective, joint ownership would encourage them to go for an OBC (P9). Joint ownership will be acceptable only if product development is involved, parties have a risk appetite for joint investments, and a 50-50 partnership or a win-win situation in surplus sharing is envisaged (P13, P18, P27). This type of ownership structure is desired and recommended for better credibility towards desired outcomes (P30, P33).

(C) *Joint ownership with veto rights*: Allows carve-outs for both provider and customer to items which are most critical to the outcome (P2). Having a stake in the assets developed in a contract

for a provider will have a major bearing on its investment decisions (P15). Similarly, it provides the customer with the ability to veto certain decisions related to those assets (P17). Joint ownership of data is enabled in this ownership structure and data becomes crucial in any customer-centric business since marketing models are built on the data accumulated over a period of time (P25). When one party wants to retain a level of control or protect its interests, the joint ownership forms will promote collaboration. Veto rights can influence investment decisions by providing a mechanism for one party to ensure that certain conditions or criteria are met before committing additional resources (P24). Veto rights is considered rare and contradictory to the trust factor even though it aligns with the principle of the OBCs (P18, P23). However, veto rights creates challenges in terms of coordination, aligning interests, and resolving disputes between the parties (P24). The veto right offers the provider the right to make technological changes as they are knowledgeable (P28). This type of ownership facilitates the JV route and co-investment (P32).

(D) *Other Models*: The provider grants the customer certain rights to use the assets without transferring ownership (P24). This can allow the customer to benefit from the assets while still preserving the provider's control and investment incentives. In an OBC, the relationship between the parties is more symbiotic, a spectrum of ownership will evolve in a contract determined by the asymmetry of negotiating power (P10). The ownership structure has to be reviewed and ownership rights are re-allocated at checkpoints along the execution cycles (P3).

5.5.7 Leverage of technology assets in contract lifecycle

Q7. How do you leverage technology assets in any contract lifecycle: (A) pre-sales, (B) contract finalization, (C) contract execution, (D)Contract closure? Kindly explain.

Technology assets are leveraged throughout the contract lifecycle to enhance efficiency, transparency, and collaboration, and help maximize the value and successful execution (P24).

At the *pre-sales stage* of the contract, significant support was found for the use of technology assets such as automation and digital transformation as a strong selling point, a differentiator and

winner against competition, a guarantor of productivity improvement, capability, cost reduction, risk reduction and faster go-to-market. If the provider already owns assets, it is leveraged to arrive at a lower quote (P18). These assets increase the percentage of winnability (P7).

At the *contract finalization stage*, assets are used as a pricing factor, and for justification of project methodology, timeline, team formation, resource estimation and proposition of mutual benefit (P2, P25). Technology assets are used to showcase the proof of concepts and to build credibility during the contract (P30).

Equally significant support for leveraging the assets during *contract execution* has been found. Providers use assets to demonstrate value and efficiency by sticking to the ex-ante proposed methodology and design (P2).

At the *contract closure stage*, providers will determine what tools/assets can be harvested from the project legally as a residual benefit (P2, P18).

In summary, technology assets are leveraged in all phases of the contract lifecycle. Higher leverage happens in presales and contract execution.

5.5.8 Technology preferences – automation and digital transformation

Q8. In an OBC context, which asset is most preferred: (A) Automation (B) Digital Transformation (C) Both? Kindly explain.

Most participants prefer both assets equally. As the automation assets start throwing up more information, the digital assets become more sensitive... - which in turn places a higher level of expectation on the automation assets (P10). This cycle will repeat until the marginal utility reaches zero. Without digital transformation, no automation (P28). They lead to long-term savings (P22). However, some can distinguish the strength of these two assets in the context of OBC. Providers create more RPAs as a matter of sustenance and digital assets could enhance stickiness with

customers (P32). Participants strongly believe that automation is essential to streamline and fasten the business processes, increase productivity, and substitute human agents if the outcomes are measurable and improve the overall bottom line (P13, P14, P17, P18, P9, P21). Digital transformation is a paradigm which evolves along with the contract to enable remote collaboration, to open up new opportunities and increase the overall top line.

5.5.9 Reputational Incentives - own reputation

Q9. Does the reputation of the provider in the eyes of the customer change over time? A) Increases, (B) Decreases, (C) No change. What are the factors which influence such a change and how provider responds to this change?

Reputation is based on the integrity, trust, transparency and understanding between the partners when they invest in each other (P18). The direction of reputational change depends on the provider's technology expertise and execution capability, cost control capability, and willingness to change and adopt modern technologies. It also depends on relationship management, flexibility and adaptability, level of responsiveness and communication, intensity of engagement at all levels of customer organization, and the overall quality of services. The direction of dynamics depends upon the market reputation of the service provider (general reputation), a reputation built within the customer engagement (specific reputation) and commitment to certain values in behaviour. (P20). The reputation increases if the provider meets/exceeds KPIs, accuracy and quality, delivers higher returns, customer delight and other value targets, and delivers transformation via better marketing and internal stakeholder management. The customers become advocates to potential customers and will influence to increase the vendors' reputation in the eyes of customers (P24). The reputation also increases if the provider demonstrates incremental outcomes at every checkpoint (P4). The likelihood of provider reputation increasing is higher in an existing contract (P21). The reputation is never static and changes over time (P9). If service remains more or less the same, reputation will decrease as customer expectations tend to keep increasing. Providers need to keep raising the bar by benchmarking against the competition (P9). The reputation will also fall if ex ante promises are tough to execute ex post (P19). Willingness to communicate protocols and scope changes and on-time delivery will raise the reputation (P33). If AI or

automation model is exposed to more data, then the predicted outcome can become more refined (fine prediction) and it can produce better outcomes with the provider's reputation rising as the contract gets executed (P14, P15).

Unless the provider can constantly anticipate value-addition possibilities and demonstrate how that can be accomplished, the customer will find the utility of the provider solution dropping over time (P10). The data show that the reputation of the provider tends to increase temporarily at the initial stages of contract execution and then either decreases or stays the same unless the provider continues investments to save costs and deliver higher outcomes to the customer. This is because today's differentiators such as automation and digital can become tomorrow's commodities (P1). If the level of service remains more or less the same, the reputation will decrease as customer expectations tend to keep increasing (P10, P28). Frequent changes in the provider's leadership decrease the reputation (P32). The reputation can be maintained if any change in perception is responded to with velocity and transparency (P13).

5.5.10 Reputational incentives – Counterparty reputation

Q10. How does the provider's reputation change in front of other customers when one of its customers faces sudden reputation loss due to a crisis? (A) Increases, (B) Decreases, (C) No change. Kindly explain.

The reputation is not an impulsive incident, and it has been gained over some time. Just one of the incidents, will not change it (P12). Each enterprise customer has their own provider reputation assessment process, however, there will be increased scrutiny and observation if the provider is entangled in a reputational crisis with another customer (P2). There will be no change in the provider's reputation if the reputational loss is because of the customers' turbulence and the provider has nothing to do with it. The reputation of the provider is likely to fall if customer turbulence is due to ethics and integrity (P9). The reputation of the provider increases if the provider sticks to the contract even after a dent in the customer's reputation, as the provider will be considered a trustworthy partner (P22, P32). Since service providers operate in an imperfect

market of emerging technology in an oligopolistic provider environment, one-time incidents will not change the provider's reputation (P10). Providers need to explain to the rest of the customers their point of view and give assurance, particularly when the ownership is joint, and the risk is shared (P13, P6, P29, P15). A series of such occurrences will impact the providers' reputation (P12). It is particularly so if the crisis garners media attention or public scrutiny (P24). The reputation of the provider will decrease if the reputational loss is because of the provider's performance. If the crisis is due to an exogenous environment such as war or business downturn, it does not impact the service provider (P25).

5.5.11 Text Analysis

The text analysis was performed in Nvivo 14, Windows 11 Pro, Intel i7-8650U CPU @ 1.90GHz environment. In addition to the primary players – providers and customers – service and technology emerged as major themes. This was followed up by reputation, ownership, digitization and automation assets, investment, and risk as second-level themes (Refer Fig. 5.2, Fig 5.3). It shows the equal importance given by the participants to these themes in successfully provisioning OBC services.

Sentiment Analysis

The following Fig 5.4 shows the sentiment analysis performed by Nvivo over the responses. It shows that more than 50 per cent of responses were found neutral, 15 per cent were positive, and 35 per cent were either negative or mixed. It indicates participants' approach towards the study was level-headed and less biased. The positive instances indicate their eagerness and excitement in outcome-based contracts.

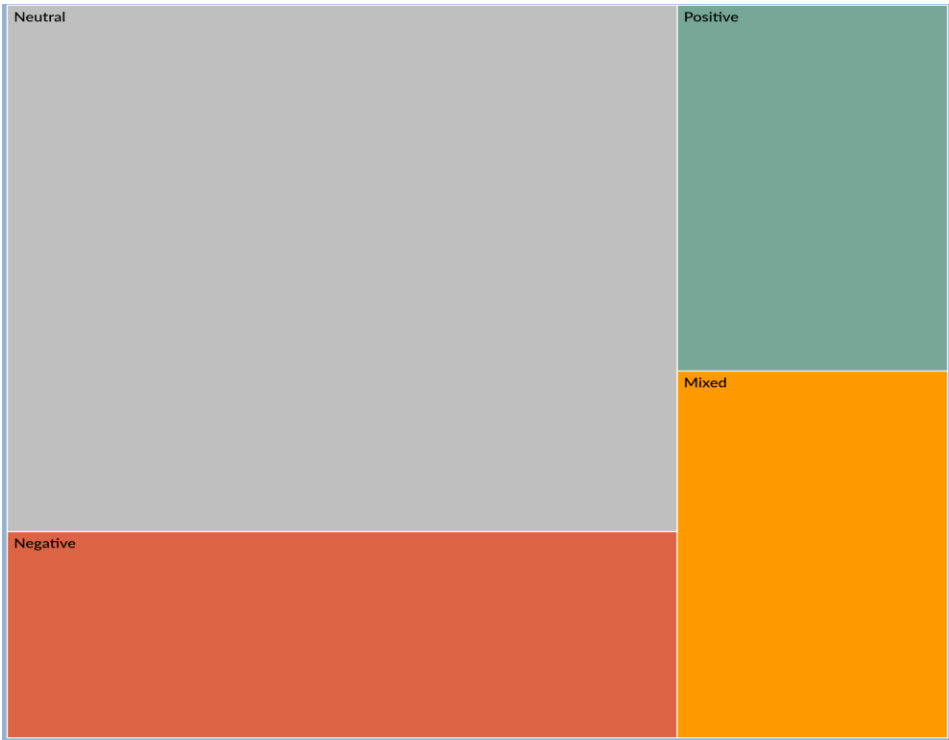


Fig 5.4. Sentiment analysis

Table 5.3 provides the summarised findings and data analysis to test the propositions.

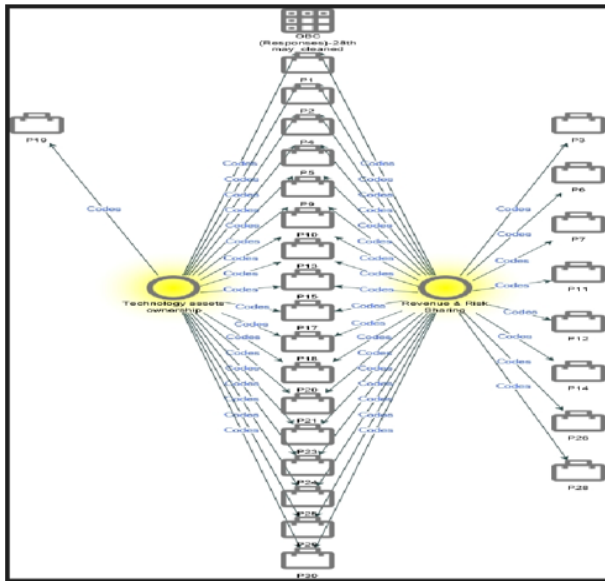
Table 5.3

Summarised findings from the qualitative study.

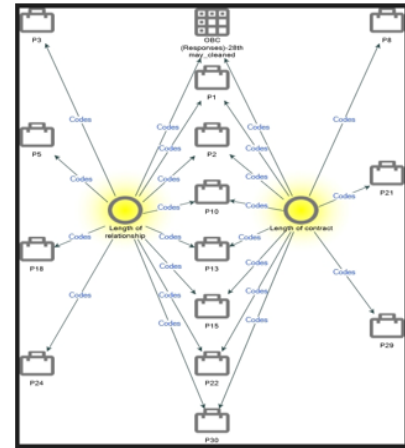
Propositions	Summarised Findings from Survey
<i>Proposition 1 (P1): For a provider with ownership of AA and DT assets, there exists a reputation level $\alpha^* \in (0, 1]$ at which the provider is a substitute to its customer in providing OBC services.</i>	Illustrative responses: Technology assets ownership helps to monetize the common part of the delivered solution, optimize costs (P9), and control IP which is critical for outside options (P10, P13). AI is a bigger attraction than traditional opportunities (P18, P23, P25). Contract length and relationship length give insights into the reputation of the customer based on the way of working, unstated facts, which help better planning, decision-making, and risk-taking (P13). Reputation is a clear trust factor, helps to overcome short-term issues (P22), and induces investing for continued success (P24). No prestigious client can be lost, and it is worth the price to pay (P18). Automation improves the bottom line and digital transformation improves the top line. Both technologies improve each other as a cycle (P13, P14, P17, P18, P9, P21). Data Analysis (Fig. 5.5): The large support for both (i) the joint effects of “technology asset ownership - risk & revenue sharing;” and (ii) “length of relationship-length of contract” indicate the influence of reputation and technology asset ownership. The key finding is that estimation of revenue & risk sharing as a joint process, equal sharing, and reputation-generating contract attributes- length of relationship and contract are keys to success. Both AA and DT assets are sources of a reputation for a firm to provide OBC services.
<i>Proposition 2 (P2): Joint ownership of complementary assets with veto rights is the most appropriate structure for OBC transactions.</i>	Illustrative responses: Joint ownership is acceptable if the contract involves product development and parties have a risk appetite for 50-50 joint investments as a win-win (P13, P18, P27, P30, P33). Veto rights can influence investment decisions for a higher level of commitment (P24). Veto rights are rare in the industry and contradictory to the trust factor (P18). It aligns with the principle of the OBCs (P23) but contains challenges for coordination, interest alignment, and dispute resolution (P24). Parties prefer to keep ownership of their respective assets - software and data in individual ownership (P21, P24, P27). Ownership increases returns and value for the long term. Customers insist on ownership if they pay for development (P16, P5). The concept of ownership is redefined with cloud services where there is no ownership except access rights (P13). Customers should own data due to regulatory and privacy restrictions, and transfer to providers not advocated at today's maturity level (P13, P18). Joint ownership offers the best commitment to investing if the outcomes are favourable or share the losses (P1, P24). Data Analysis (Fig. 5.6): There is tension between customers and providers to own their respective assets. Joint support for Individual ownership and demand

	for ownership of incremental project assets shows the pursuit of outside options as the most influencing incentive in show current entry strategy. Large support for revenue and risk sharing (RRS) indicates recognition of risk and the need for safeguards. Support for joint ownership+RRS shows the intention for hybrid ownership as a safeguard. Joint ownership + veto is a true reflection of OBC's objective though veto rights are uncommon and challenging to manage. Ownership of data to a service provider is not preferred either by the provider due to governance inability and regulatory issues such as GDPR or by the customer due to loss of competitive advantage.
<i>Proposition 3: Intra-firm reputation interaction at service provider (P-3):(i)Investment incentive to AA as general reputation decreases in DT as specific reputation. (ii) Any rise in one of the reputations counters the fall in other reputations and vice versa.</i>	Illustrative responses: At pre-sales, technology assets are a selling point, a separator from the competition, a promise for productivity improvement, cost, and risk reduction and fast go-to-market (P18). At contract finalization, assets help with pricing, project methodology, resource estimation and formation, timeline, proof of concepts, and proposition of mutual benefit (P2, P25, P30). Providers can leverage assets during contract execution for value and efficiency by aligning to the proposed method and design (P2). Providers determine tools/assets that can be harvested at the contract closure stage (P2, P18). In summary, assets are leveraged across the contract lifecycle – higher at presales and contract execution phases. Both AA and DT capabilities are in use. Automation substitutes the processes measured as SLA and volume (fixed task list) and DT as new opportunities and expanding tasks (P13, P17, P18, P9, P21). AA focuses on the bottom line and DT on the topline (P14). Data Analysis: Both AA and DT assets are sources of reputation. Equal leverage of both assets at the ex-ante (general reputation) and ex-post (specific reputation) stages of the contract. AA substitutes the processes measured in SLAs and volume to boost the bottom line (static task list) and DT evolves along with the contract as new opportunities to boost the topline (dynamic tasks). Both have complementary effects on the outcome and a fall in one reputation is countered by the rise in another.
<i>Proposition 4: (P4):(i) Inter-firm reputations affect performance of outcome-based contracts in the same direction. (ii) Outcome-based contract transfers reputations such that higher the reputation of the customer, the higher the reputation of the provider.</i>	Illustrative responses: Reputation has a tendency to increase for a short time, then either decrease or remain the same until the provider invests in a higher outcome (P4, P21). Today's high technologies are tomorrow's commodities (P1). The direction of reputation flow depends on the provider's assets, and expertise. The dynamics are a function of reputation in public (general reputation), and reputation in customer/contract engagement (specific reputation) (P20). Provider needs to keep investing since the benchmark is set by competition (P9, P28). Any reputation damage requires a transparent and speedy response (P13). Prediction accuracy leads to a rise in reputation (P14, P15). Reputation is based on integrity and when they invest in each other (P18). Provider reputation is likely to increase higher in an existing contract (P21). Constant value-addition is necessary or else the utility of the provider falls (P10). The reputation of a provider increases if he sticks to customer-facing reputational damage showing as a friend in need (P22, P32). Provider reputation falls if the customer's reputational damage is due to him, and remains at the same level if the customer is the reason for it. The provider's reputation is affected if the customer's reputational damage is due to integrity and ethics (P9). One-time incidents will not affect but a series of occurrences will impact the provider's reputation (P10, P12). Providers should explain to their customers their point of view and give assurance (P13, P6, P29).

Data Analysis: The reputation of each party affects the reputation of the other party to the contract. He must earn his reputation and there is no free ride just by being a vendor of a reputed party. The outcome/performance delivered by the provider matters in customer (contract) specific transfer of reputation.

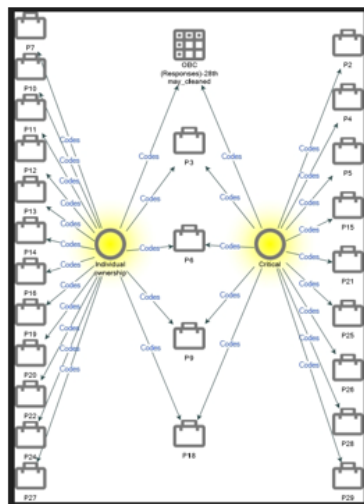


Technology asset ownership - risk & revenue sharing

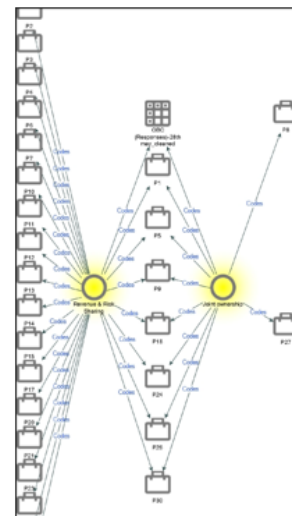


Length of relationship-length of contract

Fig. 5.5. Text analysis for Proposition 1



Individual ownership and demand for allocation of ownership



Revenue & Risk Sharing - Joint ownership

Fig. 5.6. Text analysis for Proposition 2

6. RESULTS AND DISCUSSION

A research study should result in laws relating causes to the effect or solution to a problem (Saunders et al., 2009). The conclusions drawn from the results are used to explain why a state of the world occurs in that way. A pragmatist research philosophy encourages the use of results to improve the organization of a particular state in which the researcher is embedded.

6.1 INTEGRATION OF FINDINGS AND REVISION OF PROPOSITIONS

The results from both methods are triangulated and compared for convergence, divergence and complementarity (Creswell, 2009; Östlund et al., 2011). The integrated findings lead to the revision of the propositions as shown in Fig. 6.1 to 6.4. Table 6.1 presents the revisions of the propositions accordingly.

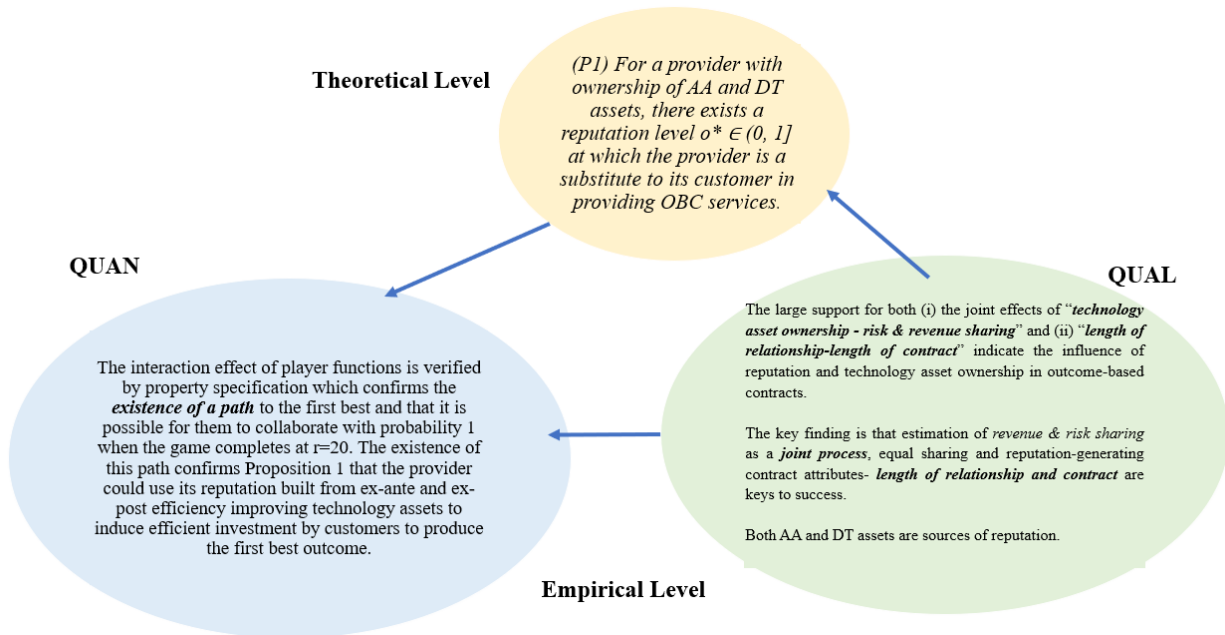


Fig. 6.1. Integrated Finding for Proposition 1

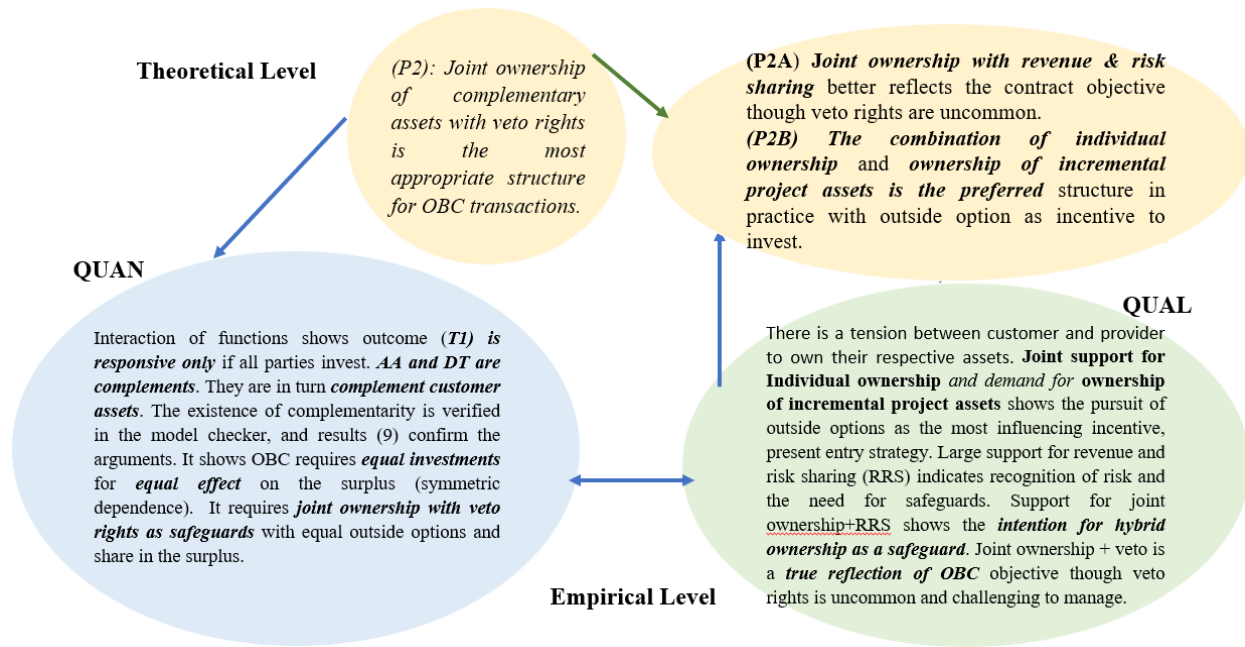


Fig. 6.2. Integrated Finding for Proposition 2

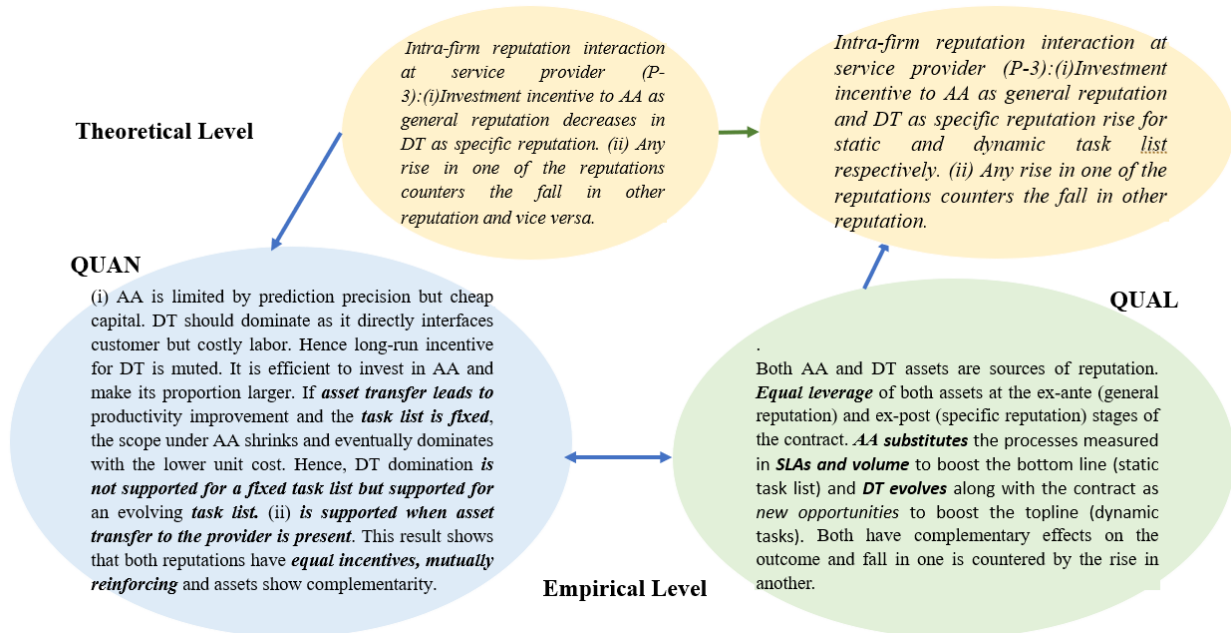


Fig. 6.3. Integrated Finding for Proposition 3

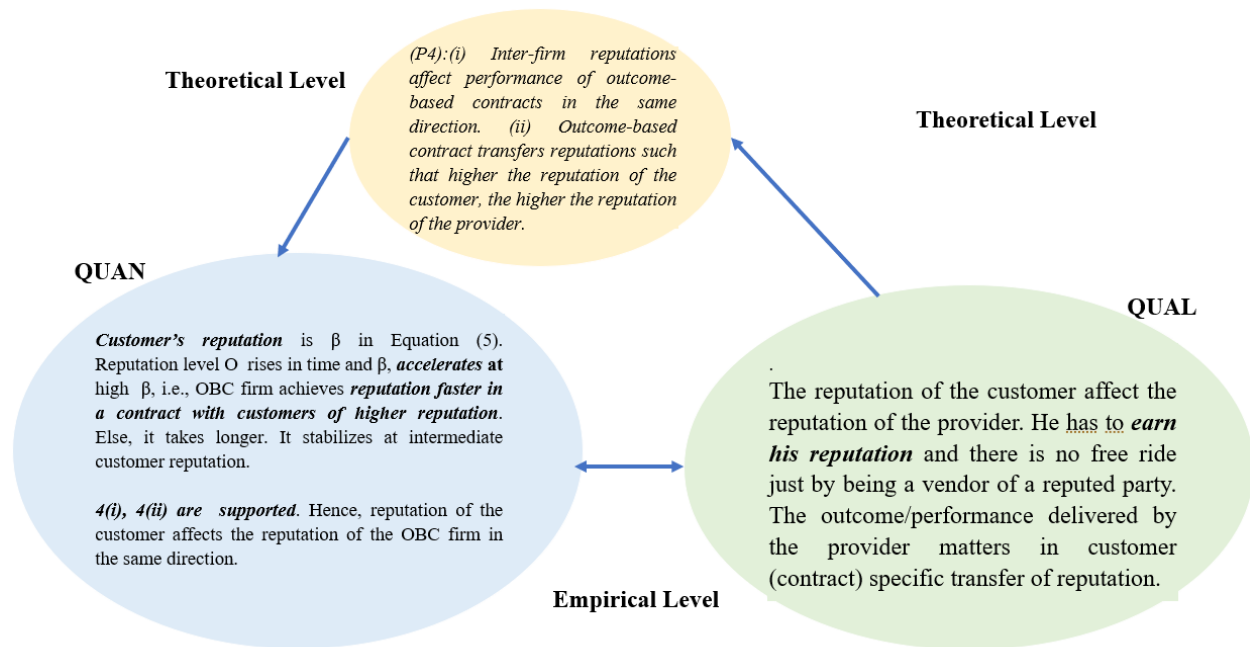


Fig. 6.4. Integrated Finding for Proposition 4

6.2 REVISED PROPOSITIONS AFTER TRIANGULATION

By comparing the results from simulation and qualitative data for their convergence, divergence and complementarity, the revised propositions are given in Table 10.

Table 6.1

Revised propositions based on integrated findings.

Conceptual Propositions	Revised Propositions post-triangulation
<i>Proposition 1 (P1): For a provider with ownership of AA and DT assets, there exists a reputation level $o^* \in (0, 1]$ at which the provider is a substitute to its customer in providing OBC services.</i>	Both findings converged on the proposition

<i>Proposition 2 (P2): Joint ownership of complementary assets with veto rights is the most appropriate structure for OBC transactions.</i>	(P2A) Joint ownership with revenue & risk sharing better reflects the contract objective though veto rights are uncommon. (P2B) The combination of individual ownership and ownership of incremental project assets is the preferred structure in practice with outside options as an incentive to invest.
<i>Proposition 3: Intra-firm reputation interaction at service provider (P-3):(i)Investment incentive to AA as general reputation decreases in DT as specific reputation. (ii) Any rise in one of the reputations counters the fall in other reputations and vice versa.</i>	(P-3) (i)Investment incentive to AA as general reputation and DT as specific reputation rises for static and dynamic task list, respectively. (ii) Any rise in one of the reputations counters the fall in another reputation.
<i>Proposition 4: (P4):(i) Inter-firm reputations affect performance of outcome-based contracts in the same direction. (ii) Outcome-based contract transfers reputations such that higher the reputation of the customer, the higher the reputation of the provider.</i>	The reputation of the customer affects the reputation of the provider. He must earn his reputation and there is no free ride just by being a vendor of a reputed party. The outcome/performance delivered by the provider matters in customer (contract) specific transfer of reputation.

6.3 INSIGHTS AND IMPLICATIONS OF THE STUDY

Table 11 lists the answers, insights and implications gained from this study that link the technology, ownership, and reputations by keeping the research objectives (RO) and research questions (RQ) as the prompt:

Table 6.2
Insights and implications.

Research Objective & Research Questions	
RO1. To establish the relationship between ownership of assets by service provider and reputation	The study establishes a strong relationship between ownership of assets by a firm and its reputation. Each asset is a source of reputation which increases in return on scale, efficiency, reliability, and prediction accuracy. A firm's overall reputation is a cumulative effect which is determined based on the interaction of intrafirm and interfirm firm reputations in contract relationships. Technological change influences the complementarity and substitutability between the reputations. Ownership is a dynamic equilibrium which oscillates among independent, joint and integration modes of
RQ1. What is the relationship between ownership of assets	

by service provider and reputation?	ownership depending upon who values the asset or who along with another party can contribute to the asset the most in terms of its future reputational dividends. Thus, the reputation of a firm is related to the functional and economic characteristics of assets it owns and their interaction affects the assets of the customer with whom the firm contracts to generate mutuality of advantage. Reputation is a consistent value (marginal value and total value) produced in a contract by the assets of the provider when used in association with customer assets. The final good produced (minimised transaction cost and maximised surplus) is the result of the interaction effect of these reputations. In an OBC, this study defines reputation as the prediction precision of AA delivering ex-ante efficiency in value creation and the minimum revenue leakage of DT delivering ex-post efficiency in value capture. This asset ownership-driven reputation is dynamic, and it is a function of the dynamic capability of the underlying asset. It tends to fall if the capability remains static or dithers against the competing firms and technologies. Reputation derived from ownership of AA & DT indicates ergodic and path-dependent dynamics depending upon the impact it makes along with customer assets.
RO2. To find out the pattern of investment optimization on assets at various stages of business to execute OBC as reputation. RQ2. How can investment in assets be optimized at various stages of business to establish OBC execution capability as reputation?	Investment incentives to AA and DT assets are given equal weights as they are complementary. Both are mutually reinforcing. At the inception stage of the business, both assets are given equal priority. Automation assets are capitalized forms of assets whose price and hence the cost of outcome produced by it may fall. Digital transformation is costly because it is a human form of asset, and its investment incentives depend upon the gap between contract task lists and tasks automated. In a growth phase or growth industry, the investment in and hence the reputation of DT dominates. The gap falls if the provider's reputation for AA increases when the industry attains stable equilibrium. The reputation of AA eventually dominates when the industry matures. At the inception level, high customer reputation and assignment of ownership rights to the incremental code is a mandatory incentive if the independent ownership of these assets is allocated to the provider. The reputation thus acquired by the provider further enhances its outside opportunities as future reputational dividends. At growth and stable equilibrium, joint ownership is the most appropriate control structure for aspirational high reputation customers particularly if ownership of customer data is involved. The ownership gravitates to common ownership or outsourcing/licensing as the industry matures depending upon whose contribution enhances the assets' reputation.
RO3. To study process of establishing service provider reputation through inter-firm interaction in OBC project. RQ3. How does inter-firm interaction happen and stabilize in OBC project as a function of service provider reputation?	The OBC is a function of independent and interaction effect of provider and customer reputations from their assets. A truthful investment establishes a path to reach the targeted realizable outcome. The provider leverages the effects as follows: OBC firm establishes a higher reputation faster in a contract with customers of similar reputation. The process takes longer and is costlier when working for customers with lower reputations. The cost of reputation rises at lower levels of customer reputation and stabilizes at intermediate levels of customer reputation. It is optimal for OBC firms to partner with customers at an intermediate level. The reputation of the customer affects the reputation of the OBC firm in the same direction. However, the survey data indicates that the provider must earn his reputation and there is no free ride just by being a

	vendor of a reputed party as envisaged by the literature of other business phenomena (Paiola & Gebauer, 2020). A dent in customer reputation will not affect the provider immediately if the reputation damage is not due to the provider. Thus, in an OBC, not only the participating assets from the contract parties (Awasthy & Hazra, 2020) but also their reputations are complementary. A combination of customers with high reputations and a fixed task list shall hasten the internalization process. A high provider reputation enhances licensing opportunities.
RO4. To study process of establishing service provider reputations through inter-firm & intra- firm interaction in OBC project. RQ4. How do inter-firm and intra-firm interactions influence the OBC service offering as a function of service provider reputations?	The study finds that the service provider must optimize investments depending upon the characteristics of the technology assets that enhance its reputation, the competitiveness of the target industry and outcome-based contract conditions as follows. (i) Rising reputation: Contract with continuous expansion of the task list increases incentives for providers to invest in both AA and DT as sources of reputation. Providers for long-run relevance need to choose such contracts. (ii) Dominance of Automation: A contract with a fixed task list offers increasing incentives to providers to invest in automation as the source of reputation at the initial period of the contract. A rise in the probability of integration with the customer (outright sale) follows when AA eventually dominates and becomes cheap. Hence, the provider needs to be wary of becoming irrelevant in fixed task list contracts. This prediction also depends upon the reputational differential between the parties. A provider with a high reputation will convert this into a licensing opportunity. (iii) Falling Reputation: The gap between realizable and realized outcomes will narrow if either industry, customer, or technologies are mature, leading to a fall in asset complementarity and set in of decreasing returns impacting the provider's reputation. In that case, at least one of the parties becomes dispensable since joint ownership of assets with declined productive values leads to a fall in the reputation of joint owners (Halonon, 2002). Under non-integration-based settlement (closure of OBC), the transaction becomes a regular cost-saving outsourcing contract to the service provider or internalization (common ownership) to the customer. In such contracts, the equilibrium will have no surplus sharing. (iv) Dominance of Provider Reputation: Rapid technological change (m in p1 function) would result in a rapid rise in the number of predictable states of the contract and prediction technology becomes fine, abundant, and cheap. Such changes play strongly against the sustenance of joint ownership but favour the dominance of technology firms over traditional firms. This result is reflective of concerns raised on generative AI in its ability to generate and correct software codes, quantum computing in solving problems of high computing complexity and the fast rise in reputation (market capital) of firms investing in such technologies. Such investments become the sweet spot for the service provider since it can capture a larger surplus. (v) Dominance of Customer Reputation: If automation substitutes tasks under DT, complementarity shall wane, and substitutability between AA and DT emerges. In that case, the reputation of customer marketing shall become more significant. Multiple providers shall independently invest in AA and DT solutions and compete to access the assets of the customer.

6.4 THEORETICAL CONTRIBUTION

The lack of sufficiently robust theories of the firms to explain emerging business models with blurred boundaries like the OBCs, is discussed in the literature on corporate strategy (Menz et al., 2021). Each theory of firm behaviour has strengths and weaknesses. Incorrect findings and empirical anomalies show that researchers are either disconnected or outsourcing phenomenon has become complex that a single theory is insufficient (Alaghehband et al., 2011; Lacity et al., 2011; Post et al., 2020). Though TCE and PRT look at different contract dimensions, both favour integration as the last resort and hence they are substitutes in their predictions. Both theories obscure the importance of interactions at the other dimension by assuming symmetric information conditions – TCE assumes away ex-ante underinvestment and PRT assumes away ex-post maladaptation (Hart, 1989; Williamson, 2003). Since both theories are static game-based formulations, they also obscure the reputation effect. This study advances the lens of contract by unifying the analytical focus of its constituent theories (Hart & Holmstrom, 1986; Kreps, 1996a; Williamson, 2002a, 2002b, 2003). The synthesis led to a framework for a concurrent view of the latitudinal (ex-post, ex-ante) and longitudinal (reputation) dimensions of a contract. The framework supported the proposition that a provider is willing to substitute the customer interest if the surplus is shared under reputation effect and joint ownership. By explaining OBCs from the perspectives of technology, ownership and reputation, this study solved the research problem of why hybrid forms of OBCs exist. The derivation of joint ownership as a structural solution for the research problem adds to the study's contribution. The chosen assets - automation and digital transformation - shall alleviate contract inefficiencies rising from all contract dimensions. The interaction effect of the assets over time would determine whether OBC remains as joint ownership or transitioned to integration/non-integration. The later structures are equilibrium choices of TCE and PRT since the maturity of technology assets and/or industry competition would accumulate selfish interactions ($\beta \rightarrow 0$) in the longitudinal dimension. Such accumulating inefficiency (maladaptation or lack of order) shall cause a fall in the contract continuation probability (unravelling of reputation). By using the framework, the researcher has answered RQ1, which was based on the question, "Why should reputation have any particular implications concerning the ownership of assets?" (Grossman & Hart, 1986), p.696. Other contributions of the study are in

treating reputation as a statistic to represent the contract characteristics, and as coordinator and moderator among assets to realise contract objectives.

From a method perspective, the use of stochastic games, a computational framework to study multi-agent dynamical systems, in solving a business problem under a multi-dimensional conceptual lens is the main contribution. This contribution is in response to the recommendation in the corporate strategy literature to combine theories of firm and concepts from computer science (Menz et al., 2021; Zhang et al., 2021). This thesis has given a list of property specifications in temporal logic to encourage other researchers to choose probabilistic model checking as a simulation platform. In addition, the study's choice of mixed method is not known in the OBC literature. This study narrowed the gap in empirical literature in linking technology, ownership, and reputation in a contract phenomenon. It also addressed the lack of OBC studies in the ITS sector.

6.5 IMPLICATIONS TO PRACTICE

In addition to Table 9, this study has the following implications and applications in practice. The existence of a path for successful provisioning of OBC by linking technologies, ownership and reputation is explained under different equilibrium conditions so that practitioners can anticipate and control the resource planning and allocation decisions. tracker. The fitment of technologies to ex-ante and ex-post issues can guide the trade-off between AA and DT investments as realizable outcomes, markets and technologies evolve. Positioning OBC for a scope hitherto untouched by outsourcing and joint ownership offers strategic value for providers. Service providers can be organized as a collection of outcome-based contracts with varied levels of automation. Fermi distribution is a novel method for providers to compute target performance levels from existing performance. The reputation function is a dynamic performance measure. By treating β in equation (5) as a level of actual vs committed investment, quality of relationship and contract health, the reputation function can compute the probability of contract success. The caution on handling customer data is both a challenge and an opportunity. The use of PRISM-games for firm-level contract dynamics management is a potential novelty.

6.6 LIMITATIONS AND FUTURE SCOPE OF STUDY

PRISM and PRISM-games face a state explosion problem, do not support variables such as fractions, and limit the precision and scalability of model specification. Features such as Pareto analysis and multi-function comparisons are not yet activated in CSG-based models. These two limitations, if addressed in future versions, can improve the ability to derive better insights. The emphasis on contract theoretic themes in the qualitative study might have resulted in missing themes that have a larger bearing on the phenomenon. The qualitative study considered participants from service providers but not the customers. The response to the same data collection protocol from both parties of a contract might give better insights through the process of reflection. A qualitative study which includes both customers and providers belonging to the same contract remains an open area (Schaefers et al., 2021).

Suggested extensions for future research include: The insufficiency of existing theories of the firms calls for the use of newer theories such as complexity theory. The complex techno-social-economic-technology environment of the OBCs can be formulated as an adaptive and learning complex system. The OBC concept can be combined with technological change literature to study the implications of automation (complete contract) and labour (incomplete contract) in comparative costs of governing economies and public policy (Acemoglu & Restrepo, 2018b; S. Tadelis & Williamson, 2010). The effect of pre-processing steps such as reengineering and redesigning ex-ante on the realizable outcome can be studied. The implications of providing outside options resulting in the expansion, contraction and redefinition of firm boundaries need further study. The use of evolutionary game theory in modeling a contract phenomenon is an interesting extension. The outcome implications of evolutionarily stable strategies such as Tit-for-tat (TFT), Win-stay-lose-shift (WSLS), and memory n strategies need further study. The implications of small providers forming a collective to provision outcome-based services is an open area in corporate strategy (Jacobides et al., 2018; Menz et al., 2021). Emergent properties may be unpredictable. The investment decisions of assets and their effect on firm-level reputation can also be analysed by using multi-criteria decision methods such as *Best- Worst Method* (Garg & Kashav, 2021; Garg & Sharma, 2020).

7. CONCLUSIONS

The contract is a framework that facilitates the mutuality of advantage from voluntary transactions of resources, capabilities or goods (Buchanan, 2001). The dominant theories of the firms under the lens of contract – TCE and PRT explain the existence of firms by using two different concepts. The TCE uses the concept of “governance structures” based on each structure’s comparative efficacy over the transaction cost. The transaction cost is an overarching concept which represents the operational concepts such as frequency, specificity, and uncertainty. The “firm as a governance function” chooses the governance structure for a transaction which is tuned to its operational concepts by offering the least cost ex-post (Williamson, 1985). In contrast, the PRT uses “property rights” as the overarching concept. The theory uses “misallocation” and “underinvestment” as ex-ante, and “contracted rights” and “residual rights” as ex-post operational concepts. The firm “as a collection of ownership rights” owns the residual rights of assets to whom it or jointly with another firm, can offer the most marginal value (Hart, 1995; Hart & Moore, 1990). The TCE and PRT are comparative contractual construction at ex-post and ex-ante dimensions of a contract respectively (Williamson, 2002b). The common concepts between these two theories are “incomplete contract” and “strategic behaviour” (Kreps, 1996a, 1996b). An incomplete contract uncontracts actions for unforeseen contingencies giving ex-post bargaining power to the asset owner. The effect enters into the theories’ respective focal dimensions – increase in governance cost or mutual underinvestment - affecting surplus efficiency. Both theories are of short-horizon models. In contrast, a long horizon model allows a reputation construction wherein a player, given the authority, chooses mutually beneficial behaviour that maximizes the surplus. The theory of reputation necessitates mutually observable contract states and behaviour of stable patterns in the initial period with both conditions repeated indefinitely (Kreps, 1996b, 1996a). The short horizon payoff shall be lesser than the discounted long horizon total payoff with a discount factor of close to one.

The phenomenon of “outcome-based contracts” covered in the literature with the concept “outcome” has varied interpretations. The extant OBC literature emphasizes the interpretation as the “*availability* of productive use of the asset” of the provider in the customer environment (Hou

& Neely, 2018). The phenomenon is variously called “performance-based”, “servitisation” or “managed services” (Grubic & Jennions, 2018). The literature contrasts this phenomenon with traditional “effort-based” or MRO contracts. The OBCs primarily transfer the ownership and maintenance risks to the supplier. The supplier mitigates by investing in reliability and monitoring and contracting for the long term (Guajardo & Cohen, 2012). The benefit to the customer is asset efficiency and to the supplier is the long-term revenue stream.

However, the focus of this study is to view outcomes as “economic results at the customer end” (also called e-OBC). The e-OBCs reduce costs for customers and increase revenue for the provider (Grubic, 2018; Bohm et al, 2016). These contracts were considered as “intentional but not evident “inconclusive” or “aspirational.” In contrast to availability contracts, Grubic and Jennions (2018) defined e-OBCs as “functional results from the complex capital-intensive asset of long-life and its breakdown is consequential to the customer,”(Grubic & Jennions, 2018). An availability contract offers a guarantee against breakdown, but an e-OBC guarantees the asset’s function at the right quality and time. However, Grubic & Jennions (2018) concluded that the absence of monitoring renders e-OBCs infeasible. In contrast, hybrid forms of the OBCs were reported in the practice literature as in Section 1. Thus, the literature did not explain e-OBCs sufficiently.

This study viewed the OBC concept as “provider substituting what customer used to perform” which reflects the implementation in practice. The OBC substitutes the provider for a hitherto “inseparable function” of the customer that has economic consequentiality in monetary terms. The consequentiality might be reduced cost or increased revenue at the customer end. The substitution requires the provider to embed naturally as a “*link*” in the customer’s hierarchy. Hence, the focus should be on the “*governance structure of the link*.” The choice of theories to construct the conceptual framework was influenced by the under-theorization of the OBC and the insufficiency of theories of the firms to account for the digital environment (Kohtamäki et al., 2019; Menz et al., 2021; Schermann et al., 2016; Selviaridis & Wynstra, 2015). This insufficiency might have driven Grubic & Jennions (2018) to “infeasibility of OBC” conclusion. This is the distinct premise chosen by this study.

The above premise led to the construction of the conceptual framework by synthesizing TCE, PRT and the theory of reputation. The framework is used to highlight and elaborate the characteristics of the OBC. The elaboration helped to explain how the interactions of the concepts and technologies representing the contract dimensions can shape the parties' behaviour to realize objective outcomes. The OBC is redefined as a contract that deals with the *hitherto inseparable function* of a firm to reach *hitherto unrealized levels of business performance*. The redefinition has rescued the phenomenon from a “supplier-owned” model of availability to a more intense “joint ownership” model of business performance. This redefinition connects the business aspiration and technological capability of parties to the OBC. The conceptual framework developed in this study provides an integrated lens to analyse, explain and predict any multi-dimensional phenomena.

The framework developed in this thesis and the OBC concept have profound implications in the design of AI applications, multi-agent reinforcement learning (MARL) and dynamical systems (Hernandez-leal et al., 2019). The OBC is a linear combination of complete and incomplete contracts. The proportion of completeness evolves along with certainty-improving technologies such as automation which performs contract gap-filling (Agrawal et al., 2018a). The framework offers a systematic approach to designing applications with various levels of autonomy. A complete contingent contract with routine tasks with no haggling on the realized state is a candidate for being a fully autonomous application. A partially autonomous application can evolve into fully autonomous as gap-filling technologies learn to coordinate adaptations to the realized states and ensure system-wide utilities that are consistent with its reputation. The application can remain partially autonomous if the scope continues to expand under joint ownership between subsystems of human and autonomous agents. The distributed decision rights will generate increasing returns and transfer reputation between subsystems. Partially autonomous systems will have zero and non-zero residual control rights that will call for appropriate ownership structures.

Similarly, organizational learning models can be treated as joint maximization of exploitation of existing capabilities (complete contract) and exploration of new capabilities (incomplete contract). An economy can be modelled as a linear combination of AI capital (complete contract) and human capital (incomplete contract) to achieve specific social outcomes. A climate protection initiative

can be represented as a combination of environmentally protected areas (complete contract) and those which need policy intervention (incomplete contract) to achieve specific environmental outcomes. Researchers can derive newer insights by applying the concepts of OBCs, and complete and incomplete contracts into these applications.

This thesis shall spark research interest in both firms-based OBCs and micro-firm theoretic phenomena such as autonomous collective systems, e.g., networks of robots, unmanned aerial vehicles, and connected cars. This family of phenomena shall be often revisited by the researchers and resolved in every respect.

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APPENDIX A: DATA COLLECTION PROTOCOL

(1) Do you have experience in offering managed services contracts? What are the main capabilities expected for such contracts? Kindly explain. (2) Are you aware of Outcome-based contracts? Kindly explain their distinct features you noted against traditional contracts. (3) Given any contract, do providers prefer to invest in: (A) internal development of technologies, (B) 3rd party licenses? Kindly describe situations where you prefer (A) or (B). (4) In an OBC, which factor(s) should influence the investment decisions of providers: (A) Revenue & Risk Sharing, (B) Technology assets ownership, (C) Length of relationship, (D) Length of contract, (E) Unknown uncertainties, (F) other factors you know? Kindly explain your choice(s). (5) In an OBC, shall the assignment of ownership of technologies/software developed to the provider is essential to induce investment? (A) Highly critical, (B) Critical, (C) Not required? Kindly explain. (6) In an OBC, kindly choose the preferred ownership of project assets (software, data) between the provider and the customer: (A) Individual ownership, (B) Joint ownership, (C) Joint ownership with veto rights, (D) Any other model you know. Kindly explain the influence of choice(s) in investment decisions. (7) Kindly explain the influence of choice(s) in investment decisions. How do you leverage technology assets in any contract lifecycle: (A) pre-sales, (B) contract finalization, (C) contract execution, (D) Contract closure? Kindly explain. (8) In an OBC context, which asset is most preferred: (A) Automation (B) Digital (C) Both? Kindly explain. (9) Does the reputation of the provider in the eyes of the customer change over time? A) Increases, (B) Decreases, (C) No change. What are the factors which influence such a change and how provider responds to this change? (10) How does the provider's reputation change in front of other customers when one of its customers faces sudden reputation loss due to a crisis? (A) Increases, (B) Decreases, (C) No change. Kindly explain.

AUTHOR'S BIOGRAPHY

Ramesh Kumar Shanmugam is a seasoned professional in IT and software services, having held senior positions in leading firms. He has managed a portfolio of large and diverse deals, many of which have been breakthroughs for the companies he has worked with. His versatility is evident in his roles across technical sales and delivery, covering a wide range of technologies, business domains, and geographies. By starting the career in IT services industry during its inception, he has developed insights into the market forces that drive the growth of this industry.

Ramesh has played pivotal leadership roles in several significant projects, including the development of an expert system for research paper locator at CSIR, a full-text retrieval system for Biotech Consortium India Ltd, and the second-largest Y2K code conversion project at Tata Consultancy Services. He has also contributed to the US-based large debit bureau, LoBue-led organizational restructuring, and RBI's centralized funds management system at eFunds Inc. Additionally, he has overseen large core banking and system integration contracts at Mahindra Satyam, and managed numerous system integration deals while front-ending relationships with Hitachi and Larsen & Toubro Engineering at LTI.

Ramesh's work principle is to leverage mathematics, system design, and informational power—skills he honed during his Electronics and Communication Engineering graduation and Information Science post-graduation. He intends to utilize the framework developed in this thesis in designing innovative contracts, AI behavior and safety.

He is a member and subscriber of the American Economic Association, Strategic Management Society, Financial Times, and Wall Street Journal. He also serves as a peer reviewer for Elsevier research publications.

In his personal life, Ramesh enjoys running and weight training, music, and movies.

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