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# Analysis the Impact of Game theory (Pay-off Matrix, Nash Equilibrium) in the High Tech Industry Artificial Intelligence – Digital Assistant

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**Abstract**—In this paper we are going to discuss and analysis the formal application of game theory which require the identity of independent actors, their preferences, their knowledge, strategic acts they are allowed to make. Each independent actor is assumed to be coherent. This game theory is not limited to case analysis rather psychology, tag of war, business, economy etc.

**Keywords**— *Artificial Intelligence; Game Theory; Nash Equilibrium; Digital Assistant; Decision Analysis*

## I. INTRODUCTION

The basic tool of game theory is the payoff matrix which is a matrix gives the possible outcome of zero-sum game when player A has possible moves and player B moves. The analysis of the matrix in order to determine optimal strategies is the aim of game theory. [14]

After payoff matrix analysis we need to make a decision. Payoff matrix helps to take the decision by Nash Equilibrium [3][14] by which each firm must make its own best decision, taking as given each possible action of the rival firm. When each firm is acting that way, the outcome of the game is a Nash equilibrium. The action of each player is the best possible response to the action of the other player.

IT services can be adapted to a new culture in a variety of ways ranging from simple build changes to total redesign in the services. Some need for change becomes obvious with relatively little analysis. For example, a cursory analysis of a country will uncover the need to require AI based digital assistance if it uses a different customer service system, or to indicate product simplification when the local level of technologies is not high. [1][2] Most such superficial changes can be spotted by looking at service use patterns, the economy, and other related culture elements. [10]

## II. PROBLEM OVERVIEW

In 2017 both company focuses on Digital Assistants Solution one of the specific area of Artificial Intelligence. This is a high-tech solution for recent trends. The core feature of the system are designed to deliver an intuitive, automated experience for all digital channels by engaging customers in natural conversations using voice or text [4][5]. To add a virtual agent to your website, app, or text messaging application, this system offers customers a consistent experience in any digital

channel[7]. A familiar voice will answer their request whether it's typed into a computer, tapped on a screen or spoken into a device.

Two company LeadSoft Bangladesh Limited and M Cube Corporation are two Bangladeshi native IT companies working in contemporary system solutions. LeadSoft is a leading Software Development Company, offering custom software development, software products, offshore software development, professional outsourcing and software consultancy. M Cube Corporation has a wide variety of products, ranging from backbone infrastructure to peripheral products, including middleware which are the focus areas of Telecommunication & Telecom Software Solution providers.

For this Digital Assistant, M Cube Corporation has developed its own platform and want to serve its customer through this. The cost of RnD is huge for the platform development and already exist in the market. Whereas LeadSoft as a partner of MicroSoft Corporation, one of the leaders in IT sector an American multinational technology company is using their platform to develop the solution.

## III. FACTS

In recent years a new breed of Bangladeshi IT marketers is posing an increasingly credible challenge to go global, following in the footsteps of Japanese and European startup IT to become formidable global competitors. HI-tech IT solutions among the growing list of international brands making an impact. Here we define hi-tech as Artificial Intelligence, Block Chain, Internet of Things, Business Intelligence and Cloud Computing but not the contemporary software solution like MIS, ERP and IT support services.

Bangladesh governments subsidize high-technology industries (largely focuses on IT) because they may create benefits that spill over to other firms in the economy. That is, governments believe that high-tech industry produces a positive externality. A strategic advantage to export firms that are competing with rivals in international markets is subsidies. This subsidies might give to capture the strategic decision making of two firms, we use game theory, the modeling of strategic interactions (games) between firms as they choose actions that will maximize their returns.

#### IV. PAYOFF MATRIX AND NASH EQUILIBRIUM

##### A. Payoff Matrix between Two Firms

The lower-left number in each quadrant shows the profits of M Cube, and the upper-right number shows the profits of LeadSoft. Each firm must decide whether to deploy a Digital Assistant. A Nash equilibrium occurs when each firm is making its best decision, given the action of the other. For this pattern of payoffs, there are two Nash equilibrium, in the upper-right and lower-left quadrants. It means that if LeadSoft produce then M Cube Corporation does not and if M Cube Corporation does Deploy LeadSoft does not.

		LeadSoft	
		Deploy	No Deploy
M Cube	Deploy	-2,000,000/- / 1,000,000/-	0/- / 21,000,000/-
	No Deploy	0/- / 21,000,000/-	0/- / 0/-

Fig. 1. Payoff Matrix – LEVEL PLAYING FIELD FOR BOTH FIRM

When both the firm are to Deploy then both are going to lose BDT 2,000,000/- . If any of them decided not to deploy the system, then the deploying firm will make a profit of 21,000,000/- and other will not gain anything. If both the firm decided not to deploy, then both will gain no profit.

Best strategy for M Cube If LeadSoft produces, then M Cube is better off not producing. This finding proves that having both firms produce is not a Nash equilibrium. M Cube would never stay in production, since it prefers to drop out of the market whenever LeadSoft produces. Again, Best Strategy for LeadSoft the decision illustrated in the lower-left quadrant, with LeadSoft producing and M Cube not producing, is a Nash equilibrium because each firm is making its best decision given what the other is doing.

##### B. Effect of a Subsidy/Support/Fund to LeadSoft

As we know LeadSoft is a local company only which can avail any Subsidy or Fund or support by the LICT (Leveraging ICT) Project of Bangladesh Computer Council (BCC) under the Ministry of Post, Telecom and Information Technology of Bangladesh Government. Here is to remember that, M Cube Corporation is registered and headquartered in Singapore.

When the LICT provide a subsidy of BDT 3,000,000/- to LeadSoft, its profits increase by that much when it develop the system. Now there is only one Nash equilibrium, in the lower-left quadrant, with LeadSoft deploying but M Cube not deploying. The profits for LeadSoft have increased from BDT 0/- to 24,000,000/- while the subsidy cost only BDT 3,000,000/-, so there is a net gain of BDT 21,000,000/- in IT industry.

		LeadSoft	
		Deploy	No Deploy
M Cube	Deploy	1,000,000/- / -2,000,000/-	0/- / 21,000,000/-
	No Deploy	0/- / 24,000,000/-	0/- / 0/-

Fig. 2. Payoff Matrix – EFFECT OF SUBSIDY/SUPPORT/FUND

Best strategy for LeadSoft with the subsidy, LeadSoft now earns BDT 1,000,000/- by producing instead of losing BDT 2,000,000/-. Best strategy for M Cube will want to drop out of the market. Once M Cube makes the decision not to produce, LeadSoft decision doesn't change. The lower-left quadrant is a Nash equilibrium where each firm is making its best decision along with the action of the other is exposed or known. Furthermore, it is the only Nash equilibrium.

##### C. Cost Advantage for M Cube

M Cube Corporation has their own platform for AI with Digital Assistant which give them a cost advantage of Producing, integrating and deploying the service. Their system is so individual and no dependency on other systems. This platform provide a faster development which M Cube presume and a technology know how, easily customizable and extendable as well.

		LeadSoft	
		Deploy	No Deploy
M Cube	Deploy	2,000,000/- / -2,000,000/-	0/- / 24,000,000/-
	No Deploy	0/- / 21,000,000/-	0/- / 0/-

Fig. 3. Payoff Matrix – - COST ADVANTAGE

Whereas LeadSoft using Microsoft Bot Framework for their service development. Dependency on Bot Framework may cost in production, integration and dependency.

If M Cube has a cost advantage in the production of Digital Assistant, the payoffs are as shown here. M Cube earns profits of BDT 2,000,000 when both firms are producing and profits of BDT 24,000,000/- when LeadSoft does not produce. Now there is only one Nash equilibrium, in the upper-right quadrant, where M Cube produces and LeadSoft does not.

##### D. Subsidy for LeadSoft and Cost Advantages for M Cube

When the Bangladesh provide a subsidy of BDT 3,000,000/- to LeadSoft, its profits increase by that much when

it produces. Now the only Nash equilibrium is in the upper-left quadrant, where both firms produce. The profits for LeadSoft have increased from 0 to BDT 1,000,000/- , but the subsidy costs BDT 3,000,000/- million, so there is a net loss of BDT 2,000,000/- million in IT industry welfare

		LeadSoft	
		Deploy	No Deploy
M Cube	Deploy	1,000,000/- 2,000,000/-	0/- 24,000,000/-
	No Deploy	24,000,000/- 0/-	0/- 0/-

Fig. 4. Payoff Matrix – SUBSIDY WITH COST ADVANTAGE

Again, M Cube Corporation has cost advantages of BDT 2,000,000/- as they has their own platform for AI with Digital Assistant. M Cube earns profits of BDT 2,000,000 when both firms are producing and profits of BDT 24,000,000/- when LeadSoft does not produce.

The Profit can be maximized if any of the organization do not lunch their product and other does. Total welfare of the industry in terms of monetary value will be highest in this situation. Nevertheless, Lunching by both organization will not regret or face any potential business loss.

#### E. Analysis and Findings

- As LeadSoft is availing the LICT fund then of course they are going to deploy the service.
- M Cube Corporation has a leverage of cost effectiveness which convert them to go into the market.
- When there are two Nash equilibrium, there must be some force from outside the model that determines in which equilibrium we are. An example of one such force is the first mover advantage, which means that one firm is able to decide whether or not to produce before the other firm [14]. Both the company can resolve the issues by present their service firstly in front of customer. This is a healthy competition and both firm can avoid the tag of war.

#### F. Conclusion:

For a High-tech industry Nash equilibrium is a best way to take decision. As M Cube and LeadSoft both are in the same industry, they both need technical support from each other. IT industry touted as crucial First-mover advantage, although now there is a growing backlash against it. First-mover advantage can be instrumental in building market share. In a duopoly

Market Strategic decision are required to capture the market. Time to market is also very important. To capture the conflict resolution with strategic decision making of two firms, we use game theory, the modeling of strategic interactions (games) between firms as they choose actions that will maximize their returns.

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