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Capitalizing On Infinitesimal Calculus In Political Marketing

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Capitalizing On Infinitesimal Calculus In Political Marketing

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I. Introduction

Science and technology are driving developments in the world. They are there in communication, education, politics, and indeed commerce. There is hardly any aspect of human existence that they have not invaded.But within the domain of these twin concepts (science and technology) comes a critical element aptly called calculus. Calculus has been responsible for the change and innovative credentials of science and technology (Otonti, 1988). This is why it has become particularly urgent to draw scholarly attention to its influence in political marketing, probably as a tribute.In pursuit of the foregoing theme, a fresh analytic tool is offered to explain how political organisations behave in response to the demands of the political marketplace. To do this effectively, we examine the concept, issues, and structure of calculus as well as the political marketing theory in order to determine the role of calculus in politics. The essence is to indicate the implications of calculus for political managers.

II. The Concept and Issues of Calculus

The calcus, as it were, is a branch of mathematics while mathematics itself is the universal language of size and numbers. (Nduka, 1988). Although, this universal language is globally spoken in one form or another; over the ages, a more complicated and more technical form of it has been developed; and it is this more technical form of the language that is being studied under such branches as algebra, geometry, trigonometry, calculus, and so on (Adedayo et al, 2006; Adewoye, 2004).According to Nduka (1988), a society's grasp of this technical language of mathematics is a fair reflection of the increasing precision of its control over nature. And in the words of Hogben (1982), the history of mathematics is the mirror of civilization.The calculus, or more strictly the infinitesimal calculus, has in its domain the differential calculus, which deals with calculating the derivatives or rates of change of functions, and integral calculus, which concerns itself with integration. Generally speaking, the calculus embraces such – concepts as functions, maximum, minimum, zero, tangent, slope of a tangent, coordinates, differentiation, integration, differential equations, etc (Ayres, 1972; Thomas and Finney, 1979). Historically, Isaac Newton and Gotfried Leibniz were each credited with the independent invention of this mathematical technique called calculus in 17th century- the century in which the scientific revolution came to a climax. The most famous and most influential figure, indeed the hero of the scientific revolution of the 16th and 17th centuries was the Cambridge mathematician – Isaac Newton. Isaac Newton propounded the famous Three Laws of Motion which established the general principles of what has since come to be termed: "Newtonia Mechanics" (Otonti, 1988). According to Basil Willey (1972), this theory was the keystone of seventeenth century science. Consequently, Newton and Leibniz, two of the ablest minds of that generation, developed the new mathematical technique, the calculus which would facilitate the calculation of rates of change, with particular reference to motion. The calculus has since then proved to be a tool of the utmost power and versatility in the development of the theoretical aspects of all the physical sciences. This could be illustrated with reference to Newton's laws of motion:

(i) Everybody continues in its state of rest or uniform motion in a straight line unless compelled by some external force to act otherwise.
(ii) The rate of change of momentum of a body is proportional to the applied force and takes place in the direction in which the force acts.
(iii) To every action there is an equal and opposite reaction.

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In the language of calculus, this becomes:

$$F = \frac{d\,(mv)}{dt} \qquad (i)$$

It may be pertinent to add that Newton's second law of motion with all its ramifications has today been accepted as one of the fundamental laws of science. In other words, calculus is the mathematics of change and motion. Where there is growth; where forces is at work producing acceleration, calculus is the right mathematical tool. It is now widely used in life sciences, environmental studies, astronomy, chemistry and economics as well as the traditional applications in engineering and physics.

In fact, calculus has invaded all spheres of human activity; it is used to predict the orbits of earth satellites; to design inertial navigation systems, cyclotrons, and radar systems; to explore problems of space travel; to test scientific theories about ocean currents and the dynamics of the atmosphere, and to model economic, social and psychological behaviour. Calculus is used increasingly to model problems in the fields, of business, biology, medicine, animal husbandry political science as well as political marketing. In a nutshell, calculus is a tool of great importance and usefulness; and is a prerequisite for further studies in nearly all branches of higher mathematics (Worlu, 1989; Ayres, 1972; Thomas & Finney, 1979). One of the greatest mathematicians of 20th century – John Von Newmann (1903-1957), wrote: The calculus was the first achievement of modern mathematics, and it is difficult to overestimate its importance. I think it defines more unequivocally than anything else the inception of modern mathematics; and the system of mathematical analysis which in its logical development, still constitutes the greatest technical advance in exact thinking.

III. Rubrics and Structure of Calculus

a) Rate of change and difference quotient

When the variable x changes from the value x_o to a new value x_i, the change is measured by the difference $x_i - x_o$. Hence, using the symbol Δ (the Greek capital delta, for 'difference') to denote the change, we write $\Delta x = x_i - x_o$.

Also needed is a way of denoting the value of the function f(x) at various values of x. The standard practice is to use the notation f (x_i) to represent the value of f(x) when $x = x_i$. Thus for the function: $f(x) = 5 + x^2$, we have $f(0) = 5 + 0^2 = 5$, and similarly, $f(2) = 5 + 2^2 = 9$, etc.

When x changes from an initial value xo to a new value $(x_o + \Delta x)$, the value of the function $y = f(x)$ changes from f(xo) to f(xo + Δ). The Change in y per unit of change in x can be represented by the difference quotient:

$$\frac{\Delta y}{\Delta x} = \frac{f(x_o + \Delta_x) - f(xo)}{\Delta x} \qquad (ii)$$

This quotient, which measures the average rate of change of y, can be calculated if we know the initial value of x, or xo, and the magnitude of change in x, or Δx. That is, $\frac{\Delta y}{\Delta x}$ is a function of x_o and Δx.

For example,

given $y = f(x) = 3X^2 - 4$, we can write:

$$f(xo) = 3(x_o)^2 - 4 \qquad f(x_o + \Delta x) = 3(x_o + \Delta x)^2 - 4 \qquad (iii)$$

Therefore, the difference quotient is:

$$\frac{\Delta y}{\Delta x} = \frac{3(x_o + \Delta x)^2 - 4 - (3x_o^{\,2} - 4)}{\Delta x} = \frac{6x_o\,\Delta x + 3(\Delta x)^2}{\Delta x}$$

$$= 6x_o + 3\Delta x \qquad (iv)$$

Which can be evaluated if we are given xo and Δx. So let $x_o = 3$ and $\Delta x = 4$; (v)

Then the average rate of change of y is 6 (3) + 3(4) = 30….. (vi). This means that, on the average as x changes from 3 to 7, the change in y is 30 units per unit change in x (vi)

b) The Derivative

Frequently, we are interested in the rate of change of y when Δx is very small. In such a case, it is possible to obtain an approximation of $\frac{\Delta y}{\Delta x}$ by dropping all the terms in the difference quotient involving the expression Δx. In equation iv above, for instance, if Δx is very small; we may simply take the term $6x_o$ on the right as an approximation of $\frac{\Delta y}{\Delta x}$.

The smaller the value of Δx, of course, the closer is the approximation to the true of value of $\frac{\Delta y}{\Delta x}$.

As Δx approaches zero (meaning that it gets closer and closer to, but never actually reaches, zero), $(6x_o + 3\Delta x)$ will approach the value $6x_o$, and by the same token, $\frac{\Delta y}{\Delta x}$ will approach $6x_o$ also.

Symbolically, this fact is expressed either by the statement $\frac{\Delta y}{\Delta x} \longrightarrow 6x_o$ as $\Delta x \rightarrow 0$,

or by the equation:

$$\Delta x \longrightarrow 0 \frac{\Delta y}{\Delta x} = \Delta x \longrightarrow 0\ (6x_o + 3\Delta x) = 6x_o \quad \text{(vii)}$$

Where the symbol $\Delta x \longrightarrow 0$ is read as "The limit of ….. as Δx approaches 0".

If, as $\Delta x \longrightarrow 0$, the limit of the difference quotient $\frac{\Delta y}{\Delta x}$ indeed exists, that limit is called the DERIVATIVE of the function y = f (x).

Several points should be noted about the derivative if it exists: First, a derivative is a function. In fact, in this usage, the word derivative really means a derived function. The original function y = f(x) is a primitive function, and the derivative is another function derived from it. Whereas the difference quotient is a function of xo andΔx, it should be observed from equation (vii), for instance, that the derivative is a function of xo only. This is because Δx is already compelled to approach zero, and therefore it should not be regarded as another variable in the function. It is imperative to add that only the subscripted symbol has been used so far is order to stress the fact that a change in x must start from some specific value of x.Second, since the derivative is merely a limit of the difference quotient, which measures a rate of change of y; the derivative must of necessity also be a measure of some rate of change. In view of the fact that the change in x envisaged in the derivative concept is infinitesimal (i.e., Δx --0), the rate measured by the derivative is in the nature of an instantaneous rate of change. Third, there is the matter of notation. Derivative functions are commonly denoted in two ways. Given a primitive function y = f(x), one way of denoting its derivative (if it exists) is to use the symbol f (x), or simply f'; this notation is attributed to the mathematician Lagrange. The other common notation is $\frac{dy}{dx}$, devised by the Mathematician Leibniz. (Actually, there is a third notation,

Dy, or Df (x), but this may not be used here.

The notation f'(x), which resembles the notation for the primitive function f(x) has the advantage of conveying the idea that the derivative is itself a function of x. The reason for expressing it as f' (x) rather than, say, (x) – is to emphasize that the function f' is derived from the primitive function f. the alternative notation, $\frac{dy}{dx}$, serves instead to emphasize that the value of a derivative measures a rate of change. The letter d is the counterpart of the GreekΔ, and dy differs from $\frac{\Delta y}{\Delta x}$ chiefly in that

the former is the limit of the latter as Δx approaches zero. Using these two notations, we may define the derivative of a given function y=f(x) as follows:

$$\frac{dy}{dx} = f'(x) = \Delta x \longrightarrow 0 \frac{\Delta y}{\Delta x} \quad \text{(viii)}$$

c) *Rules of Calculus*

The calculus, as it were, is a branch of mathematics dealing with differentiation and integration of variable quantities. The rules of calculus can be examined from these two dimensions – differentiation and integration.

d) *Rules of Differentiation*

Indicated below are three elementary rules of differentiation:

Rule 1: The Constant Rule:

If h(x) = cf(x) then $h^i(x) = cf^i(x)$ for any constant c.

This rule tells you how to find the derivative of a constant multiple of a function: differentiate the function and multiply by the constant.

Rule 2: The Sum Rule

If h(x) = f(x) + g(x) then $h^i(x) = f^i(x) + g^i(x)$.

The rule tells you how to find the derivative of the sum of two functions: differentiate each function separately and add.

Rule 3: The Difference Rule

If h(x) = f(x) – g(x) then $h^i(x) = f^i(x) – g^i(x)$.

This rule tells you how to find the derivative of the difference of two functions: differentiate each function separately and subtract.

e) *Rules of Integration*

Just as there are rules of differentiation, we can also develop certain basic rules of integration. These rules are heavily dependent on the rules of derivation with which we are already familiar. From the following derivative formula for a power function:

$$\frac{d}{dx}\frac{(x^{n+1})}{(n+1)} = x^n \ (n-1)$$

For instance, we see that the expression $x^{n+1}/(n+1)$ is the primitive function for the derivative function x^n ; thus, by substituting these for F(x), and f(x), we may state the result as a rule of integration.

Rule I : The Power Rule:

$$x^n \ dx = \frac{1}{n+1} x^{n+1} + C \ \ (n=-1) \qquad \text{(ix)}$$

Note that the correctness of the results of integration can always be checked by differentiation; if the integration process is correct, the derivative of the integral must be equal to the integrand. The derivative formulas for simple exponential and logarithmic functions have been shown to be:

$$\frac{d}{dx} e^x = e^x \text{ and } \frac{d}{dx} \ln x = \frac{1}{x} \ (x>0) \qquad \text{(x)}$$

From these two other basic rules of integration emerge:

Rule II : the Exponential Rule:

$$e^x \ dx = e^x + C \qquad \text{(xi)}$$

and

Rule III : The Logarithmic Rule:

$$\frac{1}{x} \ dx = \ln x + c \ (x>0) \qquad \text{(xii)}$$

As variants of Rules II and III, we also have the following two rules.

Rule IIa :

$$f^1(x) \ e^{f(x)} \ dx = e^{f(x)} + C \qquad \text{(xiii)}$$

Rule IIIa :

$$\frac{f^1(x)}{f(x)} \ dx = \text{Inf}(x) \text{ Fc } [\ f(x)>0\ ] \qquad . \text{(xiv)}$$

or $$\ln/f(x)/ + C \ [\ f(x)=>0\ ] \qquad \text{(xv)}$$

The bases for these two rules can be found in the derivatives rules.

Rule IV : The integral of a sum.

The Integral of the sum of a finite number of functions is the sum of the integrals of those functions. For the two-function case, this means that:

$$[f(x) + g(x)] \ dx = f(x) \ dx + g(x) \ dx \qquad \text{(xvi)}$$

This rule is a natural consequence of the fact that:

$$\underbrace{\frac{d}{dx}[F(x) + G(x)]}_{A} = \underbrace{\frac{d}{dx} F(x) + \frac{d}{dx} G(x)}_{B} = \underbrace{f(x) + g(x)}_{C}$$

In as much as A=C, we can write:

$$[f(x) + g(x)] \ dx = F(x) + G(x) + C$$

But, from the fact that B=C, it follows that

$$f(x) \ dx = F(x) + G \text{ and } g(x) \ dx = G(x) + C_2$$

Thus we can obtain (by addition)

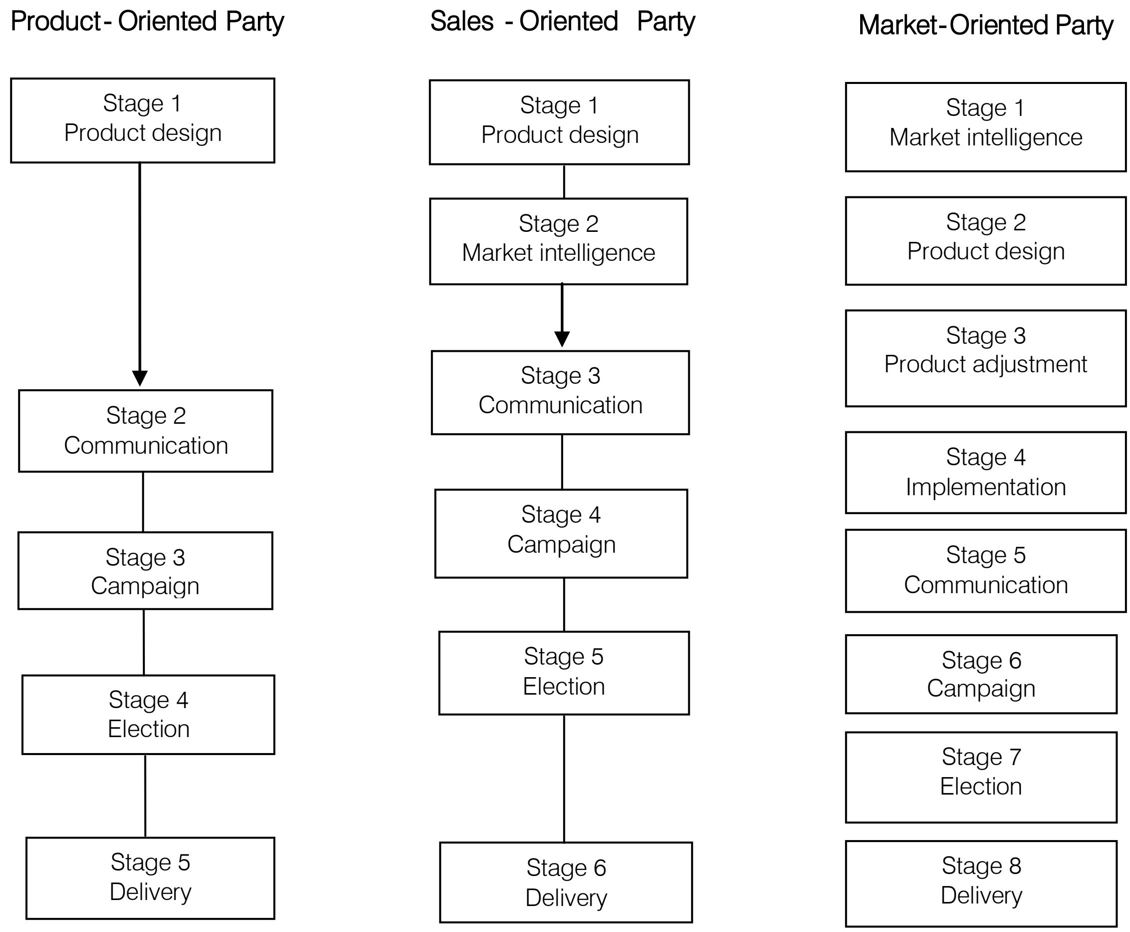
$$f(x)dx + g(x)dx = F(x) + C_1 + C_2 \qquad \text{(xviii)}$$

IV. Political Marketing Theory

Political marketing represents a marriage between political science and marketing. It draws from the techniques of political science and marketing in the implementation of party agenda. This cross-disciplinary match derives more from marketing which offers several orientations to explain business behaviour. These are product, sales and market-orientations. As will be shown later, these three orientations can be applied to party behaviour.Marketing also uses a process to depict activities, such as market intelligence which businesses engage in. these are presented as a 'marketing mix' or '4ps': product, pricing, promotion, and place. This can be formed into a chronological process consisting of various stages a party will go through within one electoral cycle. To do so, the 4Ps need to be significantly altered to create more appropriate activities. In other words, the 4Ps need considerable stretching to make much sense in politics. (Scammel, 1999). Certain stages overlap with political studies. The use of polls by parties, for example, exemplified by the stage of market intelligence, has become a notable area of study for political science. The marketing process does not leave it in isolation however, but connects it to the communication and design of behaviour. From marketing therefore we receive three new orientations, and a marketing process which if adapted to suit politics, produce a theoretical framework to develop our understanding of political behaviour.

V. Adapting the Marketing Orientations to Politics

Political parties can use political marketing to increase their chances of achieving their goal of winning general elections. They alter aspects of their behaviour, including policy, membership, leadership and organizational structure, to suit the nature and demands of their market. They can do this by being product, sales or market oriented. A product-oriented party argues for what it stands for and believes in. It assumes that voters will realize that its ideals are the right ones and therefore vote for it. This type of party refuses to change its ideas or product even if it fails to gain electoral or membership support. A sale-oriented party focuses on selling its argument to voters. It retains its pre-determined product design, but recognizes that desired supporters may not automatically want it. Using market intelligence to understand voters' response to its behaviour, the party employs the latest advertising and communication techniques to persuade voters that it is right. A sales-oriented party does not change its behaviour to suit what people want, but tries to make people want what it offers. A market-oriented party designs its behaviour to provide voter satisfaction. It uses market intelligence to identify voter demands, then designs its product to suit them. It does not attempt to change what people think, but to deliver what they need and want. A market-oriented party will not simply offer voters what they want, or simply follow opinion polls, because it needs to ensure that it can deliver the product on offer. If it fails to deliver, voters will become dissatisfied and the party will risk losing electoral support in the long term. It also needs to ensure that it will be accepted within the party and so needs to adjust its product carefully to take account of this. A market-oriented party therefore designs a product that will actually satisfy voters; demands: that meets their needs and wants, is supported and implemented by the internal organization, and is deliverable in government. To achieve these orientations, political parties engage in various activities, going through a marketing process. This is presented in figure 1. Further detail on each activity in the process is to be found in case 1. This representation of the marketing process differs significantly from marketing itself and also from previous studies of political marketing which do not always change marketing as extensively. One example is the pricing notion within the traditional marketing 4Ps. Wring includes this in studying campaigns, building on Niffernegger. But although it has some utility for campaigns (the cost of advertising for example) it has less for party behavior as a whole. This has therefore been altered considerably to ‘product adjustment’. Place is also discarded because although it is appropriate for the study of campaign organization it makes less sense for party behavior as a whole. Certain aspects of marketing language are nevertheless retained. Party behavior is called ‘product’ to encourage parties (and scholars) to think about party behavior as a ‘product’ to be given to voters. This is also true with product adjustment for a market-oriented party. Stages 2 and 3 could be combined, but there is utility in keeping them separate and in order to – find out voters demands first, before thinking about internal party concerns. Swap them around and you reduce the tendency of a party to look more fully at the electorate rather than internal members. Nonetheless members, at least in the British context, could be considered, alongside the other components of stage 3. Other aspects of the process are designed to integrate similar and /or equally valuable understanding from both marketing and political science, such as the implementation stage. The standard marketing process does not include this as an actual stage, but within marketing literature there is much discussion of how important it is that those working within a business organization accept the idea of the desired orientation it is it to succeed. This is of particular relevance, if not somewhat problematic, for a political organization such as a party. Marketing literature also offers useful guidelines for introducing a market-orientation.



Source: Lees-Marshment (2001) Political studies Vol. 49,692-713.

Figure 4.6: The Marketing Process for Product, Sales and Market-Oriented Parties.

VI. The Contributions of Calculus to Political Marketing

The importance of calculus in the increasingly turbulent political market place is evident across much of the democratic world, which is largely a response to new science and technology of electioneering. Political marketing employs some of the scientific ideas and technologies built through calculus such as are find in internet campaigning; telephone canvassing, robo-calls (involving pre - recorded messages or telephone computerized auto-dialer which can contact up to eighty electors per hour; and video imaging which enables computer generate image of the candidate to be electronically inserted into television broadcasts or pictures. This is made possible by graphic design software.Political marketing uses most of the conceptual frameworks in calculus to approach most of its quantitative problems, as in the constrained optimization problems that characterize managerial decision making. In other words, the development of optimal programmes for political marketing practice is considered a vital interest of calculus.Calculus has contributed the idea of 'change' and 'rates of change' in 'strategy mix' and application. Political marketing is not a static phenomenon. The political marketer will need to formulate certain strategies for the execution of political programmes; change and variants are bound to occur in these strategies to suit the unfolding scenarios in the political market place. Calculus also provides the idea of denoting the value of these changes and variance in strategies at various points of the implementation process. Besides, calculus teaches the political marketer that a change in one strategic variable in the electioneering process leads to a corresponding change (not necessarily in equal measure) in another variable of equal premium. The implication is that political strategist must anticipate reactive response for every strategy from competition and then prepare to minimize or neutralize its impact.There is further the concept of derivative in calculus. When this is situated in political marketing, it implies that electoral success is a derivative of the political product, marketing system, and need of the electorate, strength of competition, political environments, and party resources.Furthermore, the constant rule of differential calculus underscore the fact that in political marketing, there is no permanent foe; neither is there a permanent friend. The only thing that is constant is the 'interest' of the political marketer. This explains why there are interparty and intra-party alliances and 'gang-ups'.Again the 'sum rule' of differential calculus indicates that parties and candidates may act separately in seemingly irrational and incoherent manners. But the end will justify the means if the sum of these separate actions snowballs into success. In addition, the 'difference rule' of the differential calculus posits that the political marketer should segment the issues of interest, to enable him expunge those that do not impact positively on the 'whole. This is only possible when there is regular evaluation and analysis of the political system. On the other hand, certain rules of integral calculus have helped us to appreciate some ingredients of political marketing. For instance, the 'power rule' draws our attention to the object or the whole essence of political marketing practice. Since the derivative of the 'integral' must be equal to 'integrand', it is expected that the political strategist should be mindful of the strength and credibility of the political marketing mix particularly the product, much as we know that politics is a game of number, we should not lose sight of the need to have a preponderance of men of calibre. That is people whose collective endowments (in terms of goodwill, education, financial resources, political structures, networks, character and connections) will give competitive advantage to the party.

VII. Conclusion

Political marketing practice occurs in a turbulent field environment, and an organisation embedded in a turbulent field has no model in economic theory, except being responsive to change gradients such as research and innovation. This is the basic message of calculus to political marketing. Ideologies for the political parties will vary according to the personalities that people each party. However, there must be measurable objectives by which electoral success can be ascertained using the techniques of planning, organizing, control, and management by objectives (MBO). For the avoidance of doubt, MBO is a result-oriented method of management that establishes goals, determines how these goals are to be attained, and appraise results on predetermined dates.

VIII. Managerial Implications for Political Parties

At the heart of political marketing is the 'marketing concept'. This is an approach that puts the voter at the beginning rather than the end of the democratic process. Oftentimes, parties talk about citizens enjoying some democratic dividends when certain amenities are provided after electoral success. But the political marketing philosophy says that citizens will be more satisfied with the services of government if they were involved at the start, not just the end, of the electioneering process. Thus political parties can capitalize on change dynamics espoused in calculus in this direction. New political marketing theory now contends that the digital and global best practices massively expand democratic values, thereby substantially shifting further the power balance in favour of citizens. One reason for drawing scholarly attention to the role of calculus in political marketing is to add to the mini-explosion of literature on political marketing around the globe. But more importantly, to show that political marketing now thrives on the new digital technologies developed through calculus (e.g. internet, GSM, etc). It is therefore not surprising that Nigerian President – Goodluck Jonathan has disseminated his presidential bid through the machinery of facebook; and has been sending SMS messages to GSM customers. Political strategists are expected to capitalize on this emerging trend to reach the electorate.It is further instructive for political parties to note that their officers and supporters who have contact with the electorate have a direct influence on voter perception of their products in the political markets who almost entirely are reliant on their reputation. In these circumstances, the marketing function cannot be satisfied by a specialized campaign committee alone. It extends to all officers and supporter whose activities affect voter perception. Officers and supporters, therefore, form a vital audience – an internal market, who must be persuaded by the party's ideology and brand, since their performance crucially influences external electorate perception and continued loyalty. This is what the 'constant rule' and the 'sum rule' of calculus depict in our political marketing practice. Be that as it may, it is instructive to restrict policy development and campaign strategy to "watertight professional groups" in a more complex and fast changing political environment. This means that parties, in their drive for target voters, should increase control at the centre to achieve organisational efficiency, clarity of policy, strategy and message. This is particularly urgent in Nigeria and most other democracies where public concerns are growing on the need to make every vote count at the polls. This is where integral calculus presents a model of social justice and inclusion through its power rule. Finally, since the reason adduced for the developmental standing of the advanced democracies is primarily traceable to their grasp of science and technology with the aid of mathematics, including infinitesimal calculus; political parties should note that "the pursuit of science and technology need to form a major plank of ideology that is capable of transforming our society from mediocrity to higher levels of national development.

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