Product Customization and Customer Service Cost: An Empirical Analysis

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Abstract

We conduct a field study on a prominent US health insurance firm to examine how customizing a product affects firm’s cost to serve the customers through its call center. In our setting, the product is a complex health insurance policy. Firm incurs substantial cost in serving the customers through its call center, and adjudicating the claims using its information systems. Firm sells either standard products, or in some instances allows customer groups to customize their policy by including, modifying certain aspects of the policy. We show that the process of customization is such that it increases users’ familiarity with his/her coverage and improves the fit with his/her medical needs. This, in turn, reduces their incentives to call the firm’s call center for clarifications regarding their product coverage. In particular, we show that users with customized policies call 30% less frequently than users with standard plan even after controlling for their number of doctor /facility visits. We also show that there is no difference in claim adjudication cost between a standard vs. customized policy. Overall, our results suggest that, customized products may be operationally cheaper to serve than standard products. Thus our paper provides a link between product features and the ex-post cost of serving them

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1. Introduction

Service industry occupies a large chunk of economic activities in developed economies and is growing rapidly (CACM cite). One component of this service sector is call centers. Call centers and their contemporary successor, contact centers, have become the primary means for the companies to interact with their customers. It is estimated that 70% of the total customer-business interaction takes place through call centers (Mandelbaum 2006). AT&T estimates that about 40% of the total 260 million calls per day placed on its network are toll free calls [AT&T 1998]. Most of these are presumably to the call centers. There were more than 50,000 call centers in US alone with almost 2.65 million workers. Corporate investment in customer management and support is growing at the rate of 8% per annum. In fact, call centers constitute a major part of the entire day-to-day operations for a category of continuously delivered complex services like insurance, banking & financial services, IT and Telecom related services etc. As a result, most research on call center focuses on delivering high quality customer service at minimum cost. Much of recent work on call centers deals with capacity management & manpower scheduling issues employing analytical queuing models and human resource issues like employee coaching and churn etc. New technologies like computer telephone integration, speech recognition technology, web technology and IP telephony are also increasingly tested to not only reduce the incoming load by guiding customer to self service themselves but also more efficiently handle the given loads by intelligent call routing and lean business processes at the call centers. In all, the present emphasis on call center management is cost containment without sacrificing the quality of customer service.

Product personalization/customization (and process customization) has become a strategic necessities of the businesses in today’s competitive world. From tangible goods like automobiles, to product recommendations, to music, firms are testing and trying different personalization technologies to induce user loyalty, higher willingness to pay, etc. (Murti 2002, Dewan 2003, Ansari 2003, Chellappa 2005). Online firms like Google, Amazon, Yahoo! are trying different technologies and ways to personalize the user experience. Similarly, automobile firms like Ford and Toyota offer friendly interfaces through which buyers can design their own cars. Computer vendors such as Dell and Compaq allow customers to configure their own machines online. Levi Strauss and Gap are offering custom fit jeans and apparels for their customers. The goal of the customization / personalization is to increase customer retention, engender loyalty and hence firm profitability. There are large number of papers (both empirical and analytical) which examine the

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1 McDaniel Executive Recruiters’ 2004 North American Call Center Report, 9-23-2004
link between customization / personalization and pricing, customer loyalty, and profitability. However, ability to provide customization creates supply side problems including logistics and distribution, especially for tangible goods. Prior research indicates that customization normally leads to proliferation of product variety which is harder to manage and thus can result in higher operation cost or lower operational productivity. (Macduffie 1996, Fisher 1995 &1999). However, there is no work that we are aware of, that links product personalization with customer service costs.

In the present work, we provide evidence that product customization can have significant effect on call center demand and performance. In particular, we investigate how product customization affects customer behavior: their demand for call center services, namely the number of calls made to the call center. The managers of the firm in this study believed that the product customization efforts increase their customer service costs. The firm has taken explicit measures to standardize its products. However, we argue and then demonstrate that sometimes customizing products can lead to significant service operation benefits. In our setting, users (or a group of users) can customize their health insurance policies. Customers take initiative to customize their policies and in this process they have significant and repeated discussions with the sales representative of the firm. We argue that such a customization process for a complex product like a health insurance policy has a flavor of product co-creation. Thus, the customers and the firm typically go over the policy details to include or exclude features that fit with the users’ needs and amenable to the firm. This process, in turn, leads to a better customer fit and familiarity with the product.

Users call to the call center for variety of questions including many questions regarding product features, coverage details etc (the focus of our study). We argue that the process of product co-creation and a better fit and familiarity with a personalized product should reduce product coverage uncertainty. This, in turn, should also reduce the numbers of calls related to product characteristics and coverage.

To test this hypothesis, we collect a rich individual level data set from a health insurance firm.\footnote{The firm is a large health insurance firm which offers variety of health products to different organizations in the US. In the data set, users (or a group of users) select either standard plans or customized plans (customized based on the group requests). In the customized plans, the users make explicit changes to the policy to fit their needs. To control for various unobserved effects,} Due to disclosure agreements, the firm name will remain anonymous.
we follow the group over a period of time such that one set of randomly selected groups make a switch from a standard product to a customized product, while the other set continues to remain on the same plan. We then capture the detailed call volume data and show that on average, when users move to a customized plan, their calls (related to product information in particular) reduce by about 30%. We see no such evidence when users move from customized to standard plan or when they switch from one standard plan to the other. We find no evidence that this reduction in product related call volumes are driven merely by specific trends in call volumes of the groups changing product. We also find that the reduction in call volumes persists for the whole year after switching to the personalized plan. We further controlled for the number of claims filed by the customer groups to show that our results are not driven by any systematic change in number of doctor/ facility visits by our selected groups with change in product. We also show that the customer groups, who called more often on the standard product, reduce their product related calls more due to migration to personalized product as compared to the customer groups who made less calls. We also find that suspension rates for the claims of customers are not affected by their shifting from standard plans to the customized ones. This indicates the robustness of the computer system and processes followed at the firm and suggests that the claims processing cost does not change with product customization.

Our study is significant in many ways. First, most studies in manufacturing and service industries have focused on customization - productivity tradeoff. There is no work which has examined the link between customization and customer support (especially call centers). Our study provides an evidence of operational benefit on service operations and customer support. Thus, it highlights how product characteristics can affect customer service costs. Second, our study focuses on service industry, the largest component of US economy. Third, our study is also unique in that we conduct a field study and collect rich group level actual usage data. The panel nature of the data allows us to control for various unobserved effects providing robust estimates on the impact of customization.

This paper is organized as follows. In section 2, we provide literature review of the relevant papers in this domain. We describe our study setting in Section 3. Section 4 outlines our theoretical framework. We describe our data, econometric specifications and results in section 5. Finally, in section 6, we conclude and outline future research possibilities and limitations.

2. Related Literature
Our research draws from the literature on customization-productivity tradeoff in operations / production management and marketing / literature, literature on service sciences, literature on call center operations, and literature on mass customization and product co-creation.

With increasing competition, firms are forced to aggressively customize goods and services to attract customers, enhance customer perceived value, satisfaction and thus retain them by winning their loyalty. The personalization essentially is to create a product that fits the user needs uniquely. Thus personalization involves customer inputs and integration into product creation, a process names product co-creation (Pine 1997, Kahn 1998, Liechty 2001 and Zipkin 2001).

However, this customization is not without its cost, as the increased customization leads to proliferation of product variety and thus consequent operation complexity and productivity decrease. The literature in marketing and operations is replete with this notion of productivity - customization tradeoff. In the manufacturing operation literature, some studies have shown that the product variety leads to loss of operational productivity (Datar 1990, Banker 1990, Macduffie 1996, Fisher 1995 & 1999 and Ittner 1995). On the other hand, some other studies have shown the absence of association between the product variety and productivity (Kekre 1990, Foster 1990). The production management theories clearly suggest that larger product variety leads to additional complication of sourcing larger variety of parts, scheduling manufacturing operations for larger variety and consequent higher inventory carrying cost, machine down time, stock out situations etc. The operations literature on manufacturing side however has dealt with the strategies to mitigate these ill consequences of product proliferation viz. flexible manufacturing, product architecture and process standardization (modular product structure, vanilla box method) etc. (Ramdas 2003, Ulrich 1995, Silveira 1998).

The marketing literature however finds product variety a necessity for firms to be competitive in the market place (Frey 1994, McCutcheon 1994). Some studies suggest that firms resorting to product customization would achieve higher customer satisfaction and therefore need to allocate lesser resources for handling returns, reworks, warranties, complaints etc. which may result in lower cost and higher productivity (Crosby 1979, Deming 1982, Juran 1988). However, other studies suggest that increased product variety and attributes lead to increased cost and thus lower productivity (Griliches 1971, Lancaster 1979).

Literature on customization - productivity tradeoff in service industry is even sparser. Most of the studies distinguish fundamental characteristics of services from goods viz. intangibility, perishability (cannot be inventoried), inseparability of production and consumption, and
consumer (with heterogeneous preferences) involvement in production (Berry 1980, Lovelock 1996, Shostack 1977, Upah 1980, and Gronroos 1990). Studies suggest that customers with heterogeneous needs and preferences will demand higher customization and thus standardization will be a greater challenge (Anderson 1997). Rust (1996) proposes that service can be broken down in the physical product, service product (warranty, contract etc.), service environment (showroom etc.) and the service delivery process. He argues that the first three parts are amenable to product design methods but the service delivery part is not and hence the challenge in service customization. However, other studies on service industries emphasize the service delivery process (rather than product) customization as a means to serve different customers (Shostack 1987, Rust 2006). Lovelock (1983) provides a useful classification of services and argues that different categories of services require different operational and marketing treatment.

Most of the research on call center has been centered on the capacity management. Variety of analytical queuing models have been developed for operational performance and capacity management at call center with different assumptions on call arrival rate distribution, service time distribution, first come first serve / intelligent call routing, call blocking and abandonment. Based on these models elaborate staff scheduling / manpower resource management models have been developed. Recognizing that agent turnover has been a major problem at call centers, a body of research has been devoted towards the human resource management issues at call centers. The customer behavior has been studied in the previous research so far but it was in terms of customer impatience modeling / abandonment behavior (Mandelbaum 2006, Mandelbaum 2003).

In summary, the literature suggests that customization, in general, leads to productivity loss for both manufacturing and service operations. As detailed above, we see that there are many empirical studies on the manufacturing industry but very few on the service operations. We also see that although the call center, a complex socio-technical system, has been researched extensively with disciplines ranging from operation management to sociology and psychology, the impact of product customization on customer service cost has not been studied so far. We fill this gap in literature with our current work. We propose a theoretical framework for analysis of impact of product customization on customer’s demand of call center based service (a major cost driver). We then validate this framework on an actual usage panel data in our field study.

3. Research Site
Our study setting is a large health insurance firm in the US. The firm sells several different health insurance policies / contracts (herein after referred to as product) to a customer base over few millions. It serves its customers through its operational unit. The operational unit performs three broad activities

1. Initial setting up and routine periodic activities - coding customers and product details in the computer system maintaining customer accounts and issuing regular invoices.
2. Call Center Services - Resolving customer’s queries through the call center (through telephones calls, emails).
3. Claims Processing – Automatic processing of claims through computer systems (where claims processing logic for different products are coded). Only claims suspended or wrongly processed from computer system are adjudicated / adjusted manually.

Activities 1 and 3 are predominantly automated by coding the benefits and claims processing logic for each product in the relevant information system of the firm. Activity 2 requires customer service representative (CSR) to resolve customer’s queries on telephone. CSRs are aided by the information system (customer and product benefit database, computer telephone integration software etc) which provides customers’ insurance product related information directly on their computer screen. However, the CSRs still require knowledge about the product and skills to search for the relevant information on different databases in order to resolve customer query. Activity 2 accounts for about 70% of the total running operational cost.

The firm normally sells health insurance policies to the members of the organization (referred to as client) through the designated client administrator in the organization. Members in the organization, either through their union or through other bodies, apprise the client administrator of their specific needs and accordingly the client administrator negotiates the appropriate policies and prices from the firm. The client administrator organizes members with same chosen product and similar demographic profile (status, annual earning etc.) in one group and thus creates multiple groups for insurance purposes within the organization. The firm thus identifies an individual member with his unique member ID number under a group number and a client number. Therefore, all the members under a group number have subscribed to the same product and usually have similarity in terms of demographics.

A typical health insurance policy (products) comprises of a set of descriptive (qualitative) and quantitative coverage. Qualitative coverage describes the eligible medical procedures, network of providers, pharmacy, drugs and the explicit exclusion in each one of these. Quantitative coverage
specifies the quantitative extent of coverage against each category of descriptive coverage e.g. coinsurance, copayments, deductibles etc. As a result, a typical product is quite comprehensive and complicated (a typical product benefit booklet runs between 70-96 pages). Such complex products are not only difficult for customers to understand but also are equally difficult for the insurance firm to administer. Over the years, the firm has also created hundreds of different products. To overcome this, in recent years, the firm developed an elaborate matrix of standard product coverage components through which a large variety of existing final products can be build (modular product structure). Such final products are termed as standard products. Since these are the existing products, their benefits and claims processing logic are coded in the relevant computer system of the firm and these have been stabilized. Moreover, the CSRs are presumably well aware of these standard product coverage components due to repeatedly answering queries on the same. However, in order to attract new customers and retain existing customers, sometimes the firm has to make deviations from these standard coverage components to accommodate the specific needs of a group of customers. Such products are termed by the firm as the non-standard products. These products are essentially “customized” products where a group of customers request specific changes to be made in “standard” product.3

The firm management was of the opinion that the non-standard products are operationally more costly, as these not only require additional upfront cost of coding but also result in higher call volumes, higher call handling time and higher claim suspension rate. As a result, the management took a strategic decision to start a new integrated service operation environment where only limited set of mainly standard products were offered. The management had set up a target of 30% higher productivity for this new environment (30% less employee to service per 10,000 customers). The firm initially gave 2% reduction in premium as an incentive for customers to migrate to this new service environment.

This new environment was introduced in July 2005 with the objective to gradually migrate the entire general customer base (other than premium customers) to this new environment in 3-4 years. Initially the firm had been successful in persuading the customers to shift from their earlier non-standard products at old environment to standard product at the new environment. However, in order to shift more customers to this new environment, the firm had to introduce new non-standard products at the new environment to accommodate specific needs of customer groups to shift them to the new environment.

3 We will continue to use the term non-standard and customized interchangeably.
3.1 Insurance Selection Process

We conducted interviews with several sales and operational managers of the firm to gain insight in the process of product sales and specifically the process of non-standard products creation. At the time of contract renewal or a new contract, the firm’s sales managers offer a set of standard products at tentative prices to the client administrator of the organization. Normally the client administrator negotiates hard on the price and by and large accepts the offered standard products as it is or with minor changes which still fit the standard product coverage matrix of the firm. However, when offered standard products do not provide for certain common medical needs of a group of members, such member groups push hard on the client administrator through their member unions/pressure groups/representatives for its inclusion. This results in a prolonged negotiation between the firm’s sales managers and the client administrator. The proposed product agreement reached at each step of negotiation is then discussed internally by the client administrator with member bodies. The firm’s sales manager in turn consults the operational managers and product development managers at back end to discuss the operational implications/feasibility of servicing such products. After several such deliberations, the agreement on final product configuration is reached, which often require firm to make deviations from the standard product coverage matrix to accommodate the specific requests of member groups. Such negotiated products are called the non-standard products in the firm. Some examples of such non-standard product creation are - (1) a consortia of school teachers aggressively negotiated to incorporate sterilization reversal procedures to be incorporated in their health plan, (2) a university graduate student association pushed hard and got additional mental health and substance abuse procedures incorporated in their health product etc.

In summary, we find that non-standard (customized) products are created by active integration of the users of the product – jointly created by the users and the firm or co-created by the users.

4. Theoretical Framework and Hypotheses

In the present research setting, we examine whether there is any significant difference in operational cost in administering non-standard (personalized) products vis-à-vis the standard products. We first identify key operational cost drivers in present set up as given in Figure 1

Figure 1: Key operational Cost Drivers
These operational cost drivers were identified by examining the impact of the product category on each of the three operational activities as below –

- **Initial Setting up Activity** - One time *coding time / cost* for a new customized product in the computer systems.
- **Call Center Activity** – *Call volumes* received for each category of product and the *average call handling time* for responding to such queries by the CSR.
- **Claims Processing Activity** - *Claim suspension (auto-adjudication failure) rate* and the *claims adjustment rate* for each product category. In the event of either failure of claims auto-adjudication or correct adjudication on computer system, additional time (cost) of manual claims adjudication / adjustment is required.

One time additional coding time (cost) for a new product is fixed and it is fairly straightforward to estimate. However, the other cost drivers are the result of complex interactions among people (both customers and CSRs), products, processes and technology (computer systems). In the present work, we face the challenge of controlling for customer heterogeneity, CSR heterogeneity and the process differences in the old and new environment (The computer systems remain the same in new and old environment).
We argue that controlling for other things, the identified productivity drivers are manifestation of interaction of product with the different entities involved in the service delivery operation as succinctly represented in Figure 2.

**Figure 2: Product Entity Interaction**

In this paper, we will focus on call volume (A) and, to an extent, on claim adjudication rate (B) and how they are affected by product customization. While average call handling time could also be affected by product customization, the firm, unfortunately, does not keep details on the time taken to respond to calls made by each customer. However, we had detail conversations with the CSRs and they believe that there is no difference in the time taken to respond to a standard product related call as opposed to customized product related call, as they answer queries based on product related information provided on their screen by computer system. Nonetheless, in this paper, we cannot verify their conjecture.

Claim adjudication rate (B) depends on how correctly the information system is coded. Computer Systems are useful in efficient administration of a complex product like health insurance product, as it not only reduces CSRs’ average call handle time by displaying the requisite product related information to CSR on his computer screen readily but also automates the standard repetitive activities and thus save precious man hours to boost operational productivity. In the present setup this is achieved by coding the product benefit and claims processing logic in the computer
system. Claims processing operation specifically requires the collation of product benefit related information from customer, facility (health provider), and drug information from several other databases. Since the non-standard product requires adding new code for the product related benefit and the claims processing logic, the probability of claims suspension in case of non-standard products is considered to be higher than the already developed standard products.

The key focus of this paper is customer call volume (A). Mostly customers call because of the difficulty experienced by them in understanding their product benefits /coverage and due to the operational process failure or delay (claims rejection, issue of inaccurate invoice or ID card etc.). For the analysis in this paper, we only include the calls categorized as product related calls. Calls received at the call center are categorized on the basis of its reasons – coded into a total of 164 reason codes. The CSRs allocate reason codes to each received call. Simple analysis of call volumes on reason codes suggested that about 48% of the total calls belong to product coverage related enquiries i.e. enquiries regarding coverage of medical procedure, facility, providers, pharmacy or drugs. The other reasons for calls were quite fragmented and were generally the failure or delay in the delivery of services by the firm e.g. failure in timely claims processing, ID card dispatch etc. We focus on product coverage related calls as explained below.

We held extensive discussions with the CSRs, operational managers at the call center and some client administrators to understand what triggers product coverage related calls from customers. We also randomly listened to a large number of live calls to understand the contents of the product coverage related calls. Most of the product coverage related calls were namely “My doctor has prescribed ----- and I was told that my plan does not cover it / is it covered under my plan?”; “I thought my plan allowed for --- specialist visits but I was told otherwise / How many specialist visits do I have in my plan?”; “What are my co-pay for out of network --- treatment?”; “What are my generic drug coinsurance rate / co-pay?””. We observe that these calls are triggered at the time of doctor / facility visit (consumption of insurance product) by the customers. At this time, customers face their instant medical needs and then they assess whether their insurance products covers their medical needs or not. If such medical needs are satisfactorily met by their product, customers do not need to call up. When such medical needs are not met by their product adequately or they are uncertain about it, the customers call up the call center. The failure of product to provide desired coverage can be attributed to the lack of fit between the product coverage and customer’s medical needs. The uncertainty in customers about their product coverage can be attributed to customers’ lack of familiarity of their product coverage.
As we noted earlier, customized products are created by the process of product co-creation. Both users and firms are actively engaged in creating such a product. Von Hippel (1998) introduced the idea of shifting the locus of product development towards customers if the agency-related cost in extracting their personal preferences is very high. Such product development by customers are done by “trial and error” and “learning by doing” in multiple steps. Traditionally firms explored what users want and then develop responsive products. Von Hippel (2002) however argued alternative approach where manufacturers abandon the attempt to understand user needs in favor of transferring need related aspects of product and services to users in form of a toolkit to create the product themselves. User toolkits / product configurators for product innovation further gained popularity with advances in internet and web technologies, as it became cheaper and faster for firm’s to allow product personalization by customers. Mass customization literature also recognizes elicitation or finding exactly what customer wants as the most crucial element of mass customization (Zipkin 2001). The literature suggests that the personalized / user designed / co-created products should match users need better and thus it should lead to higher satisfaction, higher customer loyalty and lesser occasions of required reworks, returns and warranty cost (Kahn 1998). We now argue that they should also lead to fewer customer calls.

To crystallize this notion and help derive out hypothesis, we now formally model this process.

4.1 Model and Hypothesis

When a medical need arises, consumers typically visit providers/facility. If the medical needs are met by their chosen insurance products, customers are satisfied and they have no reason to make product coverage related calls. However, if customers’ medical needs are either not completely met by their product coverage and/or they are uncertain about it – they have the incentives to call and clarify their coverage. This lack of fit (insurance does not cover their needs) or uncertainty about the features results in customer disutility and customers making product coverage related calls to the firm’s call center.

All else equal, the higher the disutility, the higher is a chance that the user will call the call center. So conditional on customer $i$ having a medical need $j$, the probability that he makes product coverage related call in respect to his medical need $j$ at time $t$ can be expressed as

$$P_{ijt} = P(dU_{ij} > U_j \mid j) \times S_{ijt}$$
Total probability of call by customer \( i \) at time \( t \) is

\[
P_{it} = \sum_{j=1}^{K} P_{ijt} = K \sum_{j=1}^{K} P(\text{disutility} > U_i - j) \times S_{ijt}
\]

Where \( du_{ijt} \) is the disutility to customer \( i \) due to mismatch between his relevant product coverage and his medical needs \( j \) that arose at time \( t \), \( S_{ijt} \) is the probability that customer \( i \) requires medical need \( j \) at time \( t \). Thus \( S_{ijt} \) indicates the salience of medical need \( j \) for customer \( i \). \( K \) are the potential medical needs, and \( U_i \) is the threshold such that a user \( i \) will call if the utility decreases below \( U_i \). This dis-utility can be expressed as a generic monotonic function of mismatch

\[
du_{ijt} = L(\text{misfit}_{ijt})
\]

Without loss of generality, customer’s potential medical needs \( K \) can then be arranged corresponding to these \( K \) coverage components. Each medical need may require more than one product coverage. For example, a medical need may require coverage in radiology as well as heart related procedure. The fit between a medical need \( j \) and the relevant coverage component is determined by the following –

1. Extent of match between the medical need \( j \) and the relevant product coverage component. If medical need \( j \) requires coverage into multiple categories, then let \( x_{ij} = \sum_k x_{ik} \) capture the distance between the medical need and the coverage available for that need under the chosen insurance plan. Higher the \( x \), more is the mis-fit.
2. Customer’s uncertainty (lack of understanding) about his relevant product coverage for need \( j \). We denote this as \( b_{ijt} \) on a scale of 0 to 1, where no uncertainty (perfect understanding) is 0 and complete uncertainty (perfect lack of understanding) is 1. \( b_{ijt} \) captures the customer’s perception of fit of his product coverage with his medical needs at time \( t \).

So the misfit between the customers’ medical needs \( j \) and his relevant product coverage component at any time \( t \) can be expressed as

\[
\text{misfit}_{ijt} = \phi(b_{ijt}, x_{ij})
\]

Where \( \phi \) is a generic monotonic function, \( x_{ij} \) is metrics for the actual fit between the needs \( j \) and the coverage provided. Higher the \( x_{ij} \), higher is the misfit. \( b_{ijt} \) indicates how clearly the customer understands this coverage \( j \) at time \( t \).
Substituting this back
\[ du_{ij} = L(misfit_{ij}) = f(x_{ij}, b_{ij}) \]

Where, \( f \) is a generic monotonic function. Recall that the probability a consumer calls is
\[ P_{it} = \sum_{j=1}^{K} P(du_{ij} > U_i \mid j) \times S_{ij} \]

Now consider the migration of the customer from a standard product to customized product.
Without loss of generality, let’s assume that one feature \( k \) of the product is customized. The probability of call by a consumer who is using customized product is
\[ P_{it}^{\text{cus}} = \sum_{j=1}^{K-1} P(f(x_{ij}, b_{ij}) > U_i \mid j) \times S_{ij} + P\{ f(x_{ik}^{\text{cus}}, b_{ik}^{\text{cus}}) > U_i \mid k \} \times S_{ik}^{\text{cus}} \]

If \( k \) is not customized (standard) then
\[ P_{it}^{\text{std}} = \sum_{j=1}^{K-1} P(f(x_{ij}, b_{ij}) > U_i \mid j) \times S_{ij} + P\{ f(x_{ik}^{\text{std}}, b_{ik}^{\text{std}}) > U_i \mid k \} \times S_{ik}^{\text{std}} \]

Customization process consists of a group of customers with common medical needs (say \( k \)) asks for either modification of corresponding product coverage or inclusion of one (if it does not exist). The inclusion/modification of product coverage should result in a better fit, or reduction in \( x \) corresponding to common medical needs. Put another way, we expect \( x_{ik}^{\text{cus}} < x_{ik}^{\text{std}} \). Second, the process of personalized product creation entails multistep negotiation between the firm and the member group. This should reduce the uncertainty about the product coverage corresponding to the medical needs or \( b_{ik}^{\text{cus}} < b_{ik}^{\text{std}} \). Finally, we also expect that users are more likely to personalize features that are very salient to them. These medical needs are more probable to occur and/or they are more important. Thus probability \( (S_{\text{in}}^{\text{cus}} = S_{\text{in}}^{\text{std}}) \) is likely to be higher for customized medical need. Therefore, reduction in \( x \) and \( b \) is likely to have a higher impact on probability of calls when \( S \) is also high.

Based on this discussion, we hypothesize that

**H1: Customers migrating from standard product to customized product reduce their product coverage related calls.**
It is also possible that the customers may customize their product coverage in expectation of their future medical needs. In this case, the value of $S_{ik}$ would systematically change for the customers after the change in product. In this scenario, the direction of change in product call volumes with customization will be ambiguous, as product customization will reduce value of $x$ and $b$ but the value of $S$ may increase. Therefore, it is imperative to control for the change in $S$ to see the net effect of $x$ and $b$ on product call volumes.

Firm is consolidating its assortment of products by discontinuing some of the less popular products and persuading the customers to pick up its standard product offerings. Therefore, due to firm’s persuasion / incentives, some customers may migrate from customized product to one of the standard offerings of the firm. Again, suppose that the feature $\hat{k}$ which was customized earlier is now standardized. It is intuitive that

1. Lack of customization is likely to decrease the fit. So $x_{i\hat{k}}$ is likely to increase.
2. Since the customer $i$ is somewhat more involved in product change deliberations now, we may expect customer familiarizes himself/herself with the coverage related to $\hat{k}$. Thus $b_{i\hat{k}}^{\text{std}}$ is likely to be lower after a transition from customized to standard then when the transition is from standard to standard or no transition.

Thus in such migration, we see that the value of $b_{ik}$ is likely lower but the fit is likely to be worse (higher $x_{i\hat{k}}$). So the change in probability of calls more ambiguous.

Our model also offers insight into how customers with different call intensities will respond to change in product coverage. Let us assume two consumers A and B have migrated from a standard product to the personalized product by personalizing a need $\hat{k}$. Suppose customer A is a heavy caller compared to customer B ($S^A > S^B$). Since $x$ and $b$ reduce equally for both A and B, it is immediate that, due to higher $S^A$, the reduction in number of overall calls will be higher for a higher intensity caller A than for B. Customers who make higher calls before migrating from standard product to personalized product reduce the product coverage related calls more due to this change.

5. Data and Methodology –
Our goal is to examine how migration of a user from a standard plan to customized plan affects his (her) calling behavior. While we have the data at individual level, since users typically make less than one call per year, we aggregated the data at the group level. As noted earlier, a group is a collection of demographically similar individuals within an organization that sign up for the same plan. We identified groups that as a whole changed their products from standard to customized and vice versa. As we mentioned earlier, the firm has been trying to move its customers to a new environment. The new environment went operational in June 2005. Initially, the firm picked the customers it wanted to move to the new environment by giving them incentive. After about 6 months, it had moved more than 250,000 such customers. By July 2006, the new environment was stabilized and all groups (not specially selected) were encouraged to migrate to the new environment. Thus this time-frame was appropriate for our sample. We could find a large number of users switching to new environment with and without customized plans. Therefore, we could get a reasonably large number of customers group changing products only along with the change in the environment.\(^4\) We should note that these customized products were specifically created for these customer groups.\(^5\)

We captured migration of customer groups to new environment with all possible change in broad product categories namely standard (S)→ non-standard (NS), non-standard → standard, one type of standard → another type of standard and customers who did not change their product at all. Normally the insurance contracts are given on annual basis from July - June and January - December. We selected July – June contract cycle, and selected the groups which have migrated to new environment in July 2006. We then randomly selected the following categories of customer groups who have changed the product and or environment in July 2006 but maintained the same product for each contract periods July05-June06 & July06-June07 –

- **S→NS Category** – 170 separate customer groups of different sizes who migrated from standard product at old environment (1\(^{st}\) July 2005 to 30\(^{th}\) June 2006) to non-standard product at new environment (1\(^{st}\) July 2006 to 30\(^{th}\) June 2007).

- **NS→S Category** – 35 separate customer groups of different sizes who have migrated from non-standard product at old environment (1\(^{st}\) July 2005 to 30\(^{th}\) June 2006) to standard product at new environment (1\(^{st}\) July 2006 to 30\(^{th}\) June 2007).

\(^4\) We could potentially go back to earlier times to collect a sample where users changed the plans but the environment was unchanged. Unfortunately, the definition of standard and non-standard was fairly vague within the firm.

\(^5\) Sometimes, the firm converts a personalized product into a standard product after some time.
- **No product change (Standard) Category (Sim S→S)** – 66 separate customer groups of different sizes who have migrated from standard product at old environment (1\(^{st}\) July 2005 to 30\(^{th}\) June 2006) to the same standard product at new environment (1\(^{st}\) July 2006 to 30\(^{th}\) June 2007).

- **Dis S→S Category** – 34 separate customer groups of different sizes who have migrated from one type of standard product at old environment (1\(^{st}\) July 2005 to 30\(^{th}\) June 2006) to another type of standard product at new environment (1\(^{st}\) July 2006 to 30\(^{th}\) June 2007).

- **S→S Category but no environment change (Old S_S)** – 458 separate customer groups of different sizes who have remained on the same standard product in the old environment for the entire period 1\(^{st}\) July 2005 to 30\(^{th}\) June 2007.

Sometimes, customers keep joining and/or leaving the groups in the middle of the year, and thus the membership count of each group varies somewhat during the period of study. Since we wish to study the impact of product change (standard to customized product) on group’s call volume, we control for change in group size by selecting only groups which did not change in size over 10% of its average size in the period of study. The summary statistics for the category wise member counts for groups is shown in Table 1.

**Table 1: Category wise member counts for groups**

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Groups</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS_S</td>
<td>35</td>
<td>80.71</td>
<td>120.27</td>
<td>2</td>
<td>558</td>
</tr>
<tr>
<td>S_NS</td>
<td>170</td>
<td>25.14</td>
<td>30.80</td>
<td>1</td>
<td>233</td>
</tr>
<tr>
<td>Sim S_S</td>
<td>66</td>
<td>49.79</td>
<td>71.67</td>
<td>1</td>
<td>371</td>
</tr>
<tr>
<td>Dis S_S</td>
<td>34</td>
<td>54.84</td>
<td>73.70</td>
<td>1</td>
<td>381</td>
</tr>
<tr>
<td>Old S_S</td>
<td>458</td>
<td>19.44</td>
<td>33.36</td>
<td>1</td>
<td>377</td>
</tr>
</tbody>
</table>

We collected weekly call data for each group of customers from the Automatic Call Distributor (ACD) of the call center. As noted earlier, we only focus on product coverage related calls by the customers. These calls account for 48% of the total call volumes. We also noticed that in the new environment, the firm widened the definition of product related call by subsuming some of the reason codes into the reason code for general product coverage enquiry. Therefore, in general, the number of product related calls increased in the new environment due to recoding. The summary statistic for weekly product related calls aggregated over the groups in each category and normalized over 5000 customers is given in Table 2 (Normalization is done over 5000 customers to clearly show the changes in calls).
Table 2: Category wise weekly product related call volumes normalized over 5000 members

<table>
<thead>
<tr>
<th>Category / Environment</th>
<th>Old Env</th>
<th>New Env</th>
<th>Old Env</th>
<th>New Env</th>
<th>Old Env</th>
<th>New Env</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS_S</td>
<td>53</td>
<td>52</td>
<td>21.17</td>
<td>24.98</td>
<td>7.65</td>
<td>7.83</td>
</tr>
<tr>
<td>S_NS</td>
<td>53</td>
<td>52</td>
<td>28.20</td>
<td>27.66</td>
<td>9.12</td>
<td>7.81</td>
</tr>
<tr>
<td>Sim S_S</td>
<td>53</td>
<td>52</td>
<td>28.31</td>
<td>32.68</td>
<td>8.51</td>
<td>8.71</td>
</tr>
<tr>
<td>Dis S_S</td>
<td>53</td>
<td>52</td>
<td>21.02</td>
<td>30.36</td>
<td>7.17</td>
<td>8.81</td>
</tr>
<tr>
<td>Old S_S</td>
<td>53</td>
<td>52</td>
<td>24.13</td>
<td>22.12</td>
<td>4.88</td>
<td>5.45</td>
</tr>
</tbody>
</table>

From Table 2, it is apparent that the mean weekly product coverage related calls are decreasing for migration from standard to non-standard products whereas for all other types of migrations, these mean weekly product coverage related calls are increasing. This suggests the reduction in calls with customization of product.

We plot the trends of weekly product coverage related calls (normalized over 5000 customers) for the users who migrate from standard to non-standard and for the users who remain on the same plan. Although there are significant weekly variations, the plot in Figure 3 shows that, on average, migration to customized plans reduce the calls.

**Figure 3: Comparison of weekly calls trends for S_NS and Sim S_S normalized over 5000 members**
5.1 Methodology

Our goal is to identify how change in product choice affects the customer call volume. However, in our case, change in product is also associated with the change in environment. There is also customer related heterogeneity. Thus, we need to weed out the effect of customer related heterogeneity, environment related heterogeneity and any time trends or seasonality on call volumes. We have a category of customer groups changing their product with change in environment (called Treatment Group) and a category of customer groups changing the environment with the same product (called Control Group 1). There is another category of customer groups that neither changes their product nor their environment (called Control Group 2). We first aggregate weekly call volumes for all the groups under each category separately and then normalize it for 5000 customers for each category. We propose the following difference-in-difference design for analysis.

Figure 4: Model A

![Diagram](attachment:image.png)

We subtract the weekly call volumes of Old S_S category for each week from the corresponding weekly call volumes for S_NS category and Sim S_S category to weed out any general time trends from them.

Figure 5: Model A
We run the pooled OLS regression on the diff-in-diff-in-diff model (Model A) by pooling the call volumes for the entire t= 105 weeks of the observation period (53 weeks in the old environment and 52 weeks in the new environment)

\[ C_{vol_t} = \beta_0 + \beta_1(T_g) + \beta_2(En) + \beta_3(T_g) \times (En) + \beta_4T + \varepsilon \]  

(A)

Where

\( C_{vol_t} \) = Aggregated weekly product related call volumes

\( T_g \) = Dummy for the treatment group

\( En \) = Dummy for the environment

\( T \) = Monthly time dummies

The sign of the coefficient of interaction term \( T_g \times En \) gives the net effect of product change on the product related call volume in this model. Although this model weeds out the effect of environment and time to give the net effect of change in product on call volume, yet it suffers from aggregation problems. The results in this model might be driven by changes in call volumes of only few groups. Moreover, this model also ignores the serial correlation in the call volumes made by a group over different weeks to be correlated.

To overcome these problems, we next take the disaggregated call volumes for each group of customers under each category separately. We then run fixed effect estimation on the call volumes made by these groups. The fixed effect estimation is a logical choice in present context since members in a group have some unobserved similarities due to the way they are clubbed within a group by the client administrator. Moreover it is reasonable to assume that these unobserved similarity will remain constant over the period of study. We first aggregate the call volumes for each group under each category for the entire year before and after the change in environment and then divide these yearly aggregate call volumes by 12 to get the average
monthly call volumes for each group before and after the change in environment. We then run the fixed effect estimation on the diff-in-diff design as shown in Figure 6.

**Figure 6: Model B1**

\[
Cvol_{it} = \beta_0 + \beta_1(Tg)_{it} + \beta_2(En)_{it} + \beta_3(Tg)(En)_{it} + \beta_4Mcnt_{it} + \gamma_i + \varepsilon_{it} \quad (B1)
\]

Where
\[i = \text{index for customer groups}\]
\[t = \text{index for time period for which the variables are recorded}\]
\[Cvol_{it} = \text{Average product related call volumes for group } i \text{ in time period } t\]
\[Mcnt_{it} = \text{Average member counts for group } i \text{ in time period } t\]
\[Tg = \text{Dummy for the treatment group}\]
\[En = \text{Dummy for the environment}\]
\[\gamma_i = \text{Group fixed effects for group } i \text{ invariant over time}\]
\[\varepsilon_{it} = \text{Idiosyncratic error term}\]

The coefficient of interaction term \(Tg*En\) gives the net effect of product change on the product related call volume in this model.

Averaging call volumes for the entire contract year helps avoid the serial correlation problem in the idiosyncratic error term for the group over period of study (24 months or 105 weeks) [Mullainathan S, 2003]. However, in this process, we lose the variations in call volumes over time for each group. So in our last model we disaggregate call volumes for each group in time dimension also. We take the monthly call volumes and actual monthly member counts for each
group of customers under treatment group and the control group. We run the fixed effect estimation on the diff-in-diff design as shown in Figure 7.

Figure 7: Model B2

\[
C_{vol_{it}} = \beta_0 + \beta_1(Tg)_{it} + \beta_2(En)_{it} + \beta_3(Tg)_{it} \times (En)_{it} + \beta_4Mcnt_{it} + \beta_5T + \gamma_i + \epsilon_{it} \quad \text{---} \quad (B2)
\]

Where, \( T \) stands for the monthly time dummies. These are included to account for any seasonality in the call volumes. In this model, we use cluster robust standard errors to account for both heteroskedasticity and any form of serial correlation in the idiosyncratic error terms across time.

6.0 Results and Discussions –

We run all three models with S_NS groups as treatment group and Sim S_S as control group. So in the control group member groups strictly remain on the same standard product after migration to the new environment and thus their call volume strictly change due to time trends and environment only. The results are given in Table 3.

Table 3: Change in product related call volumes due to migration from standard product to personalized product (standard errors in parentheses)

<table>
<thead>
<tr>
<th>S_NS Group AND Sim S_S Group</th>
<th>Model A</th>
<th>Model B1</th>
<th>Model B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tg</td>
<td>-0.104</td>
<td>dropped</td>
<td>dropped</td>
</tr>
<tr>
<td></td>
<td>(1.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>En</td>
<td>6.38***</td>
<td>0.204***</td>
<td>0.21***</td>
</tr>
<tr>
<td></td>
<td>(1.65)</td>
<td>(.07)</td>
<td>(0.07)</td>
</tr>
</tbody>
</table>
All three models show a negative and highly significant coefficient for the interaction term. This signifies that controlling for other things; customers going from standard to customized (non-standard) products make statistically lesser calls per week regarding their coverage / benefit information. Moreover this reduction in product call volumes is approximately 30% - which is also practically very significant. Our result is robust to the aggregation problem and any group level unobserved effects, as all the specifications give negative coefficient of interaction term with high significance. Thus we find support of our hypothesis.

One concern could be that simply change of plan induces these effects. To account for this, we include in our control group the users who change from one standard plan to another. The results are shown in Table 4.

**Table 4: Change in product related call volumes due to migration from standard product to personalized product with Dis S_S as control group (standard errors in parentheses)**

<table>
<thead>
<tr>
<th>S_NS Group AND Dis S_S Group</th>
<th>Model A</th>
<th>Model B1</th>
<th>Model B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tg</td>
<td>7.19***</td>
<td>dropped</td>
<td>dropped</td>
</tr>
<tr>
<td></td>
<td>(1.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>En</td>
<td>11.35***</td>
<td>0.38***</td>
<td>0.37***</td>
</tr>
<tr>
<td></td>
<td>(1.71)</td>
<td>(0.1)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Tg*En</td>
<td>-9.89***</td>
<td>-0.38***</td>
<td>-0.38***</td>
</tr>
<tr>
<td></td>
<td>(2.42)</td>
<td>(0.11)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Mcnt</td>
<td>Not applied</td>
<td>-0.024***</td>
<td>0.018***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.004)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>T</td>
<td>Applied</td>
<td>Not applied</td>
<td>Applied</td>
</tr>
<tr>
<td>Constant</td>
<td>-3.12***</td>
<td>0.072</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>(1.20)</td>
<td>(0.14)</td>
<td>(0.24)</td>
</tr>
</tbody>
</table>
The results are even stronger than the earlier specification, which further supports our hypothesis that customers shifting to customized product make lesser product related calls due to this change.

We further check the robustness of our result by testing the other possible product migrations, namely Dis S_S group and NS_S group migrations, as treatment groups with Sim S_S group as the control group in diff in diff design. The results are shown in Table 5 and Table 6 respectively.

**Table 5: Change in product related call volumes due to migration from one type of standard product to another (standard errors in parentheses)**

<table>
<thead>
<tr>
<th>Dis S_S Group AND Sim S_S Group</th>
<th>Model A</th>
<th>Model B1</th>
<th>Model B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tg</td>
<td>-4.10*** (1.37)</td>
<td>dropped</td>
<td>dropped</td>
</tr>
<tr>
<td>En</td>
<td>3.80*** (1.38)</td>
<td>0.23*** (0.08)</td>
<td>0.21*** (0.07)</td>
</tr>
<tr>
<td>Tg*En</td>
<td>1.99 (1.95)</td>
<td>0.13 (0.14)</td>
<td>0.17 (0.15)</td>
</tr>
<tr>
<td>Ment</td>
<td>Not applied</td>
<td>0.003 (0.005)</td>
<td>0.021*** (0.002)</td>
</tr>
<tr>
<td>T</td>
<td>Applied</td>
<td>Not Applied</td>
<td>Applied</td>
</tr>
<tr>
<td>Constant</td>
<td>1.99** (0.97)</td>
<td>1.07*** (0.29)</td>
<td>0.14 (0.12)</td>
</tr>
<tr>
<td>N</td>
<td>210</td>
<td>2 observations each for 100 groups</td>
<td>24 observations each for 100 groups</td>
</tr>
<tr>
<td>R squared</td>
<td>0.15</td>
<td>0.64</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Note - *** = statistically significant at the 1%, 5% and 10% levels (two-sided test) respectively.

**Table 6: Change in product related call volumes due to migration from personalized product to standard product (standard errors in parentheses)**

<table>
<thead>
<tr>
<th>NS_S Group AND Sim S_S Group</th>
<th>Model A</th>
<th>Model B1</th>
<th>Model B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>210</td>
<td>2 observations each for 100 groups</td>
<td>24 observations each for 100 groups</td>
</tr>
</tbody>
</table>

Note - *** = statistically significant at the 1%, 5% and 10% levels (two-sided test) respectively.
We find insignificant coefficient of the interaction term in all three specifications for both of these designs. Thus we find reduction in product call volumes only in standard to customized product migration and not in other kinds of product migration. This further validates our theoretical framework that the fit and familiarity factors determine the generation of product coverage related calls from the customers.

We also empirically check what happens to the non product related call volumes for customers migrating from standard to customized product. We run model B1 only as it gives consistently similar results. The results are given in table 7

**Table 7: Change in non-product related call volumes due to migration from standard to personalized product (standard errors in parentheses)**

<table>
<thead>
<tr>
<th>S_NS Group AND Sim S_S Group</th>
<th>Model B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>En</td>
<td>0.305**</td>
</tr>
<tr>
<td>(1.55)</td>
<td></td>
</tr>
<tr>
<td>Tg*En</td>
<td>0.03</td>
</tr>
<tr>
<td>(2.2)</td>
<td></td>
</tr>
<tr>
<td>Mcnt</td>
<td>0.016***</td>
</tr>
<tr>
<td>(0.15)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.34</td>
</tr>
<tr>
<td>(0.004)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>2 observations each for 101 groups</td>
</tr>
<tr>
<td>R squared</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Note - ***, **, * = statistically significant at the 1%, 5% and 10% levels (two-sided test) respectively
This puts to rest the possibility that customers migrating from standard to customized product are somehow reducing all types of calls and further supports out theoretical model of product related call volume generation.

One possible cause of negative and significant coefficient of $Tg*En$ term in our result could be the constant declining trend in the S_NS product call volumes and/or a constant increasing trend in the call volumes of the Sim S_S group (In diff-in-diff regression design we just pick up the differences in averages between the two groups before and after the change in environment). In this case the negative and significant coefficient of interaction term would not indicate change in the product call volumes due to S_NS shift. To verify this fact, we first ran the fixed effect estimation on product call volumes for S_NS group alone for entire 24 months with time trend $t$ and its interaction with environment as covariates

$$Cvol_{it} = \beta_0 + \beta_1(En)_{it} + \beta_2 t + \beta_3 t \times (En)_{it} + \beta_4 Mcnt_{it} + \gamma_i + \varepsilon_{it}$$

We find the positive and highly significant coefficient for $t$ and a negative and highly significant coefficient for interaction term $t* En$. This indicates that the product call volumes are showing an increasing trend for the S_NS group but with change in environment (& product) there is a negative and significant dip in this trend. When we run the similar regression for the Sim S_S group for the entire 24 months period of our study, we don’t find any statistically significant trend in the product call volumes. Thus we find that the significant negative coefficient of $Tg*En$ in our results are due to product change and not due to any already existing time trends as discussed above.

We also checked for the temporal trends in product call volume reduction by dividing the time in new environment in four quarters as $En1, En2, En3$ and $En4$. We ran model B2 on this setup with S_NS groups as treatment group and Sim S_S groups as control group.

$$Cvol_{it} = \beta_0 + \beta_1(En1)_{it} + \beta_2(En2)_{it} + \beta_3(En3)_{it} + \beta_4(En4)_{it} + \beta_5 Tg + \beta_6 Tg \times (En1)_{it}$$
$$+ \beta_7 Tg \times (En2)_{it} + \beta_8 Tg \times (En3)_{it} + \beta_9 Tg \times (En4)_{it} + \beta_0 Mcnt_{it} + \gamma_i + \varepsilon_{it}$$

We find that the coefficient of all four interaction terms ($Tg*En1, Tg*En2, Tg*En3$ and $Tg*En4$) are negative and significant. This shows that the reduction in product call volumes is consistent in the entire period in new environment and the average reduction as shown by overall product call volumes regression is not driven by any large reduction in a specific period in new environment.
We also checked the robustness of our results by running fixed effect poisson regression with specification B2 on our count data of monthly call volumes. We find that poisson estimation results are similar to our fixed effect OLS estimations.

We already mentioned the possibility could be that groups self select themselves into customized product in expectation of their future medical needs. In this case, the members may visit the doctor/facility more /less with customized product as compared to their earlier standard product and thus have higher / lower trigger points of making product related calls (probability of facing their changed medical coverage). In this case, the product call volumes in respect of member groups on migration to customized products may change in any direction as a net result of change in trigger points (S), change in fit (x) and change in familiarity (b). Therefore, it is important to control for the number of doctor/facility visits by the groups in our regression design to show the impact of only fit and familiarity on product related call volumes. We don’t observe the number of doctor /facility visits by the members in data but we do observe the number of claims filed by members. It is also reasonable to say that the number of claims filed in respect to a member monotonically increase with the number of doctor /facility visits by that member. So we can use the number of claims filed by the group as a proxy for the number of doctor/ facility visits by those group members. The summary statistics for the year wise claims filed by the different category of groups are given in Table 8.

### Table 8: Yearly number of claims filed by different category of groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>S_NS 05-06</td>
<td>170</td>
<td>266.59</td>
<td>304.97</td>
<td>2</td>
<td>2222</td>
</tr>
<tr>
<td>S_NS 06-07</td>
<td>170</td>
<td>265.72</td>
<td>332.91</td>
<td>1</td>
<td>2700</td>
</tr>
<tr>
<td>Sim S_S 05-06</td>
<td>66</td>
<td>489.8</td>
<td>695</td>
<td>2</td>
<td>3317</td>
</tr>
<tr>
<td>Sim S_S 06-07</td>
<td>66</td>
<td>553.15</td>
<td>763.49</td>
<td>9</td>
<td>3735</td>
</tr>
<tr>
<td>NS_S 05-06</td>
<td>35</td>
<td>694</td>
<td>913.8</td>
<td>2</td>
<td>3716</td>
</tr>
<tr>
<td>NS_S 06-07</td>
<td>35</td>
<td>829.9</td>
<td>1085</td>
<td>1</td>
<td>4345</td>
</tr>
<tr>
<td>Dis S_S 05-06</td>
<td>34</td>
<td>575.9</td>
<td>741.5</td>
<td>5</td>
<td>3676</td>
</tr>
<tr>
<td>Dis S_S 06-07</td>
<td>34</td>
<td>594.3</td>
<td>773.6</td>
<td>2</td>
<td>4052</td>
</tr>
</tbody>
</table>

We see that there is not much difference in the number of claims filed by the S_NS groups after change in product but other than that all other category of migration groups have increased their number of claims filed.
We now run the dif in diff regression design of model B1 for all possible change in products with group wise yearly number of claims (clmno) as covariate

\[ Cvol_{it} = \beta_0 + \beta_1(Tg)_{it} + \beta_2(En)_{it} + \beta_3(Tg)_{it} \times (En)_{it} + \beta_4 Mcnt_{it} + \beta_5 Clmno_{it} + \gamma_i + \epsilon_{it} \]

The results are given in Table 9.

**Table 9: Change in product related call volumes due to different types of migrations between standard and personalized products controlling for number of claims filed (standard errors in parentheses)**

<table>
<thead>
<tr>
<th>Model B1</th>
<th>S_NS Group AND Sim S_S Group</th>
<th>NS_S Group AND Sim S_S Group</th>
<th>Dis S_S Group AND Sim S_S Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>En</td>
<td>0.18***</td>
<td>0.148*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.07)</td>
<td>(0.09)</td>
</tr>
<tr>
<td></td>
<td>Tg*En</td>
<td>-0.19**</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.08)</td>
<td>(0.14)</td>
</tr>
<tr>
<td></td>
<td>Mcnt</td>
<td>0.018***</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.004)</td>
<td>(0.005)</td>
</tr>
<tr>
<td></td>
<td>Clmno</td>
<td>-0.0004</td>
<td>0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0003)</td>
<td>(0.0004)</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-0.12</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.12)</td>
<td>(0.23)</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>2 observations each for 236 groups</td>
<td>2 observations each for 101 groups</td>
</tr>
<tr>
<td></td>
<td>R squared</td>
<td>0.48</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Note - ***, **, * = statistically significant at the 1%, 5% and 10% levels (two-sided test) respectively

We find that the coefficient of interaction term \( Tg*En \) remains almost same in magnitude and statistically significant for S_NS migrations after controlling for number of claims filed by these groups. This indicates that the reduction in product call volumes in this migration can be attributed to the change in product alone after controlling for call trigger points. This in turn validates our theoretical framework that factors of fit and familiarity in the process of customization leads to reduction in product call volumes. In contrast, the coefficient for \( Tg*En \) remain insignificant and coefficient of \( Clmno \) (number of claims filed) become highly significant for both the Dis S_S and NS_S migrations when number of claims filed are thrown as independent variable. This indicates that the change in product call volumes for NS_S and Dis S_S migrations is explained by the change in number of trigger points (number of doctor/facility visits) for these groups and shows no evidence of influence of change in product attributes on
product call volumes. In other words, it supports our theoretical framework by suggesting that the factors of fit and familiarity do not change much in these migrations.

So far we have shown that achievement of higher fit and familiarity in migration to customized product leads to reduction in product related calls by controlling for all other possible observed and measurable variables affecting call volumes. However, we are not able to measure these latent constructs. We therefore provide qualitative evidence of the achievement of fit and familiarity in few sample S_NS groups. We first looked at the specific product feature change in some of the S_NS group migrations in our sample. We find that one set of groups are the auto repairing organizations, who through their association approached the firm for inclusion of more robust preventive eye/vision care in their plan. Another group is a multi-Location Company with some of its employees located at DC. This company negotiated for DC mandated mental health and substance abuse benefits for such employees which was more robust. Another group in our sample is a biotechnology company that negotiated with the firm for inclusion of non formulary smoking deterrent in their RX drug coverage in contrast to their standard closed formulary coverage. Likewise another company in our sample negotiated for the flexibility to not use Medmark for high cost prescription drug in contrast to their standard product requiring mandatory use of Medmark for high cost RX drug. Thus we find evidence of incorporation of specific requests of group/client in customized product. This should logically result in achievement of better fit between medical needs of these groups making such requests and the resulting customized product. We also held extensive interviews with some of the client administrators in our sample groups and firms’ relevant sales reps to confirm the customization process as described in the earlier section of this paper. We find that the customization process took multi-step and protracted (1.5-6 months) negotiations between firm and client administrator. The client administrators also confirmed the involvement of member bodies of their organization in the negotiation process. These evidences suggest increase in familiarity with product features among the members due to the customization process.

We sort the S_NS groups in decreasing call intensities (call volumes per member per month) and then categorize them in four categories (1) top 25% of groups as treatment group 1 (Tg1), (2) next 25% of groups as treatment group2 (Tg2), (3) next 25% of the groups as treatment group 3 (Tg3), and (4) lower most 25% groups as treatment group as treatment group 4 (Tg4). We run model B2 with 4 treatment groups and Sim S_S groups as control group. The results are given in Table 10.
We see that the coefficients of the $Tg1*En$ and $Tg2*En$ are both highly negative in magnitude and statistically significant as compared to the coefficients of $Tg3*En$ and $Tg4*En$. This indicates that the customer groups with high call intensities before the change in product have reduced the product related call volumes more with migration from standard to personalized product as compared to the customer groups with lower call intensities.

We also test the impact of migration from standard product to customized product on the claim suspension rates of customer groups. Since our objective is to see how the product category affects the claim suspension rate at the firm, we use model A on weekly claims suspension rate for the S_NS groups vis-a-vis Sim S_S groups. The results are given in Table 11.

Table 11: Change in claims suspension rate with change in products from standard to personalized product (standard errors given in parentheses)

<table>
<thead>
<tr>
<th>S_NS Group AND Sim S_S Group</th>
<th>Model B1</th>
</tr>
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<tbody>
<tr>
<td>Tg</td>
<td>$1.37^{***} (0.51)$</td>
</tr>
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</table>
We see a highly insignificant coefficient of $Tg*En$, which indicates that the claim suspension rate for the customer groups does not change statistically significantly by the change in their product from standard to personalized. This indicates that once the personalized products are coded in the relevant computer systems of the firm, the computer systems and processes at the firm are robust enough to handle both standard and the personalized product equally well. This in turn indicates no change in the claims processing cost with migration of customers from standard to customized product.

### 6. Conclusions, Managerial Implication, Limitations and Future work –

We show using actual usage data in a field study that customizing a complex product like a health insurance has a significant impact on customers demand on call center and thus cost to serve the customer. We provide the theoretical framework for the same by proposing that the factors of fit and familiarity determine the product related call volumes to the call center. Since this framework is quite generic, it would be applicable to a wide variety of service industries, which are selling complex service products and then servicing them through the call centers. In the present empirical setting, we find that customers migrating from the standard offerings to the customized product on an average make 30% fewer product related calls due to this change. With the annual customer service outlay of US $ 43 million, shifting of even 10% additional customers to customized product may translates into savings to the tune of US $ 0.50 million for the firm (This assumes same average call handle time - a reasonable assumption as firm’s computer system is fairly robust once the customized product is correctly coded in it).

Our study shows the result which appears intuitive but surprisingly it is quite contrary to the prevalent beliefs in the working managers. Since most of the literature so far has only talked about the customization-productivity tradeoff, possible benefits of product customization on operations side has not been much researched. We show that one major operational cost drivers.
can be reduced by customizing the product to meet customers’ needs. It requires accounting for the other cost drivers to get the net effect of product customization on the overall operational cost. However, in complex service products where the products are predominantly serviced through the computer systems, the possibility of reduction in operational cost with product customization cannot be denied. Moreover, most of the studies on call center talks about the work force resource planning etc given the customer consumption load. We believe that our study goes a step back and traces the causes of call volume generation in a call center and thus gives important insights to the managers for effectively reducing the load on call center at first place rather than only telling how to better manage the given load.

From our interviews with the field managers of the firm, we found that the product customization (non standard product creation) is achieved by effectively integrating (directly or indirectly) the customers in co-creation of product. The firm’s managers communicate with the customer groups through the client’s group coordinator to understand their needs and then select the most suitable product from among the standard offerings and modify it to fit customers’ needs. In this process the managers also help customers understand what product coverage suits their needs best and thus familiarize the customers with their product coverage. Thus we find that the customization process starts with the customer pull and then finishes with the firm’s push. The process of customization here essentially follows the three elements of mass customization [Zipkin 2001]. (1) It starts with elicitation of customers needs clearly. (2) Then the closest standard product that matches customer needs is identified and further required modification in standard product is determined. In this process the technical and financial feasibility of such changes are also evaluated. (3) Finally the required adjustments in the operations to service such customized product are affected. The present research shows that the customization process, if handled systematically, can reduce the product related call volumes. We feel that our current work shows not only the cause for a result but also the process through which this result is achieved. Thus it has a lot of informative value for the practicing managers.

Our empirical study also shows no evidence of increase in consumption load by the customers, who change from customized product to the standard product. One possible explanation for it could be that customers once exposed to customization process, subsequently carefully matches his needs with the offered product before taking it. Therefore such customers achieve higher familiarity without sacrificing much on fit element in the new product, even if it is the standard offerings and thus do not make higher product call related calls. This could have significant
managerial implication, as the managers would then like to guide the customers with personalized product towards one of their low cost standard products with appropriate incentive schemes. However, it is just a conjecture at this stage and needs further empirical validation before putting into practice. This could be an interesting future extension of our present research.

One obvious limitation of the present work is our inability to measure the latent factors of fit and familiarity. It would be interesting to study how call volumes vary with variation of these factors. We covered the product –customer interaction and product – IT system interaction in the present work. A logical extension would be empirically test the product - CSR interaction to assess the overall customization-productivity relation. Moreover, we have taken only one year period before and after the change of product. One may argue that the product familiarity due to deliberations at the change process may wear off after some time and therefore the call volumes may then increase. We feel that the familiarity with the product should increase with more experience with the product but still the analysis on a larger time frame may further clarify these issues.

In summary, our work shows that the product customization is not per se operationally bad as it is prevalently believed. It shows that co-creating complex service products with effective customer integration can in fact lead to reduction in subsequent consumption load by the customers. This finding (on the actual usage data in a field study) has large managerial implication for the rapidly growing call center based service operations in the complex service products like insurance, banking and financial services, IT and Telecom related services etc.

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