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Abstract

Technologies for the delivery of financial services, such as ATMs, home banking and other self-service media, are having a profound impact on the design of retail banks' delivery systems. This paper presents the results of an empirical study based on a probability sample survey of 117 United States retail banks in which the channels of delivery for typical banking products are investigated. This research tests several of the basic assumptions of a conceptual framework depicting the relationships between service content characteristics and service delivery channels. Specifically, this paper considers how banking services (transactions and inquiries) generally vary according to the type of delivery channel emphasized by the bank for its target market (industrialization level) and according to the number (span) of delivery channels available to the customer. It also shows the relationship between these two key factors in delivery system design, industrialization and span.

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Introduction

This article presents an empirical study examining the delivery channels used for the distribution and handling of transactions and inquiries typical of American retail banks. It tests several features of Huete's (1987) delivery system design matrix in the context of retail banking services (see Exhibit 1). This matrix depicts the relationships between service content and delivery channels. It can be used as a framework for analyzing the customer-contact portion of a service delivery system.

A retail bank can give primary emphasis to any one of a number of distinct delivery channels, each of which entails a different level of industrialization,[1] and it can provide its customers with a number of choices on how they may interact with the bank. These two factors, span and industrialization level, are critically important for the design of a retail banking delivery system. This paper will empirically show how banking services vary according to: a) the type of delivery channel emphasized by the bank for its delivery, and b) the span (number) of distinct delivery channels through which it is made available to its customers. It also depicts the explicit relationship between these two key factors in delivery system design, industrialization and span for typical banking services.

The delivery system of a retail bank comprises the aggregate of delivery channels through which service contents are delivered to a customer (e.g., teller, ATMs, etc.). As noted by Huete (1987), "service content" is what is delivered to a customer (e.g., cash advance, financial planning, etc.) while a delivery channel is the sociotechnical system through which a service content is delivered to a customer. Either factor by itself is incomplete in defining a service. Together, service content and a delivery channel create a "service encounter." A service encounter[2] is to a retail bank and its customers what a "product" is to a manufacturing firm.

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[1] The term "industrialization" is, in this research, understood as the "substitution of systems and technology for people" (Levitt, 1976).

[2] In retail banking, a service encounter is sometimes called an "offering."

If we consider that a delivery channel and service content are the components of a bank's "product," then we can easily see what great strategic opportunities for differentiation exist for retail banks through deployment of new technology based delivery channels (ATMs, point of sale, mail, phone, home banking, etc.). Furthermore, these channels can deliver a growing number of services to an increasing number of consumers in cost-effective ways.[3]

Consequently, the past decade has witnessed systematic changes in the ways that customers may interface with retail financial institutions for the provision of services. The traditional emphasis on personal service has been replaced, in many cases, by technology-based delivery channels in which the customer performs many of the tasks integral to the creation and distribution of the service. This widespread change has been made possible by the availability of new technology for delivery activities, as well as by the willingness of customers to assume an increasingly active role in the service creation and distribution process (Lovelock and Young, 1979; Fitzsimmons, 1985).

Background

Earlier evaluations of service operations management research are reported as suffering from a narrow focus (Miller and Graham, 1981; Sullivan, 1982; Mabert, 1982). These authors urge service operations researchers to take a broader view in their efforts, to establish linkages with other fields, and to pay more attention to the front-office portion of the service delivery; in other words, the area where customer interaction takes place and where managers need to integrate many functions such as marketing,[4] operations and personnel.

This research explicitly addresses the second of these demands by studying the delivery system design of retail banks. It examines the service delivery system design of banks within a theoretical framework discussed at length elsewhere (Huete, 1987). This framework presents a matrix, depicting the relationships between a service content and delivery channels, that can be used as a framework for analyzing the customer-contact portion of service systems (see Exhibit 1). The framework is based on Chase's (1981) customer contact model and the general form of the "product-process" matrix of Hayes and Wheelwright (1979a) for manufacturing.

As can be seen in Exhibit 1, along the top of the matrix are listed two broad scale continuums of service complexity and customer knowledge. The matrix itself is divided into three levels (low, medium and high) of "potential standardization of a service content." Along the side of the matrix are service delivery channels, placed relative to an industrialization level continuum. The ordering of the channels listed above implies that industrialization level increases as the amount of front-office employee contact in the provision of the service diminishes; therefore, decoupling of client-employee contact is higher in the channels located at the bottom of the matrix.

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[3] The average operating cost of completing one ATM transaction in 1987 was 66 cents, according to a Nilson Report mentioned in *The New York Times*. Compare this with the average teller cost of between 90 cents and $1.20 (*The New York Times*, Sep. 9, 1987).

[4] This need to balance the requirements of operations and marketing is found in many strategic service management decisions such as process and job design, location, capacity, scheduling, quality, automation, productivity, etc. Roth and Van der Velde (1988b) discuss the strategic linkages between marketing and operations in retail banking delivery systems.

The upper right-hand and lower left-hand corners of the matrix are expected to be "void." Both regions represent a natural mismatch between delivery channels and the degree of service content standardization: the upper right hand corner is postulated to be uneconomical and the lower left-hand is an emerging area. In the past, the upper right-hand corner was an area of rather normal service encounter activities. Nowadays, this (the use of an expensive delivery channel for a fairly simple service content to a highly knowledgeable customer) is uneconomical, although it can be justified if the sales opportunity that arises from the encounter is greater than the cost penalty.[5] The lower left hand corner represents the delivery of service contents that require high customization using technology-based, self-service channels. For the most part, today, such delivery channels are simply too inflexible to accommodate the provision of service contents in which the customer requests are heterogeneous and unpredictable.[6]

Like the manufacturing matrix of Hayes and Wheelwright (1979a), the proposed service matrix suggests that there are "diagonal matches" in which a certain kind of service content and set of customer characteristics are paired with their "natural" delivery channels. The match represented by the diagonal in Exhibit 1 represents the portion of the service encounter "natural" area (everything that is outside the two marked corners) in which the marketing and operations trade-off that arises in the different types of service encounters is best solved. The area above the diagonal but outside the marked corner represents natural service encounters in which production efficiency is sacrificed for the sake of a potential sales opportunity. Similarly, the area below the diagonal but outside the marked corner represents service encounters in which a potential sales opportunity is sacrificed for the sake of production efficiency.

Delivery System Design Variables: Industrialization and Span

The design of delivery systems in retail banking is viewed as entailing two major decisions: 1) which delivery channel should receive the most managerial attention and resources, and 2) the number of different delivery channels (span) that will be made available for the customer to interface with the retail bank.

The industrialization of services has found a champion in Theodore Levitt. Levitt argued (1972, 1976) that service operations managers ought to stop thinking of service as servitude and instead take a manufacturing approach to service by substituting "technology and systems for people." The ability to "industrialize" service operations, in the opinion of Levitt, will result in a leap in productivity, comparable to that which was achieved during the industrial revolution of the early 1800's. The first stage of service industrialization occurred in the backroom. Only recently have banks' managers begun to place a comparable emphasis on improvement of delivery system productivity by increased use of automated equipment and the direct transfer

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[5] However, some United States banks, in an effort to use the front-office as a marketing tool, are exploiting this niche. They are advertising "excess front office" capacity for the delivery of all banking products (Roth and van der Velde, 1988b). Therefore, even though from an operations perspective the area is uneconomical, the joint marketing-operations coupling adds economies of scope.

[6] In the foreseeable future, new developments in software (data bases, artificial intelligence, expert systems, etc.) and computer-telecommunication equipment is going to allow the delivery of a customized service through an industrialized delivery channel. An example of what Davis (1987) would term "mass customization" is the Trintex system. Trintex, a subsidiary of Sears and IBM, is beta testing a home shopping and transaction processing service which includes banking services.

of elements of the service creation and distribution process to the consumer and to back-room operations.[7]

The span (number) of delivery options is related to the following question: what effect is produced on the management of a service system by having several delivery channels coexisting within the same system? If one were to apply to service system the "focused factory" concept developed by Skinner (1974) for industrial systems, one would conclude that a variety of delivery channels within a single service system would greatly complicate the management of the system. This is particularly true due to the complexity associated with increased industrialization.

Thus, there are good reasons for anticipating that both the number of delivery channels (span) available to customers and the one particular channel emphasized for the target market will vary according to different banking services. Exhibit 1 displays the matrix with empty upper right-hand and lower left-hand corners (uneconomical and emerging areas, respectively). That is, it is hypothesized that service contents with either low or high potential for standardization, on average, would be delivered through fewer channels than services with medium standardization potential. Also, when the match between service contents and delivery channels is displayed as a diagonal, it is implied that different service contents will "match" with different delivery channels. In other words, that banking services vary in the level of industrialization involved in their delivery. These features of the matrix are empirically tested in this paper.

This discussion of the conceptual framework suggests three major research questions related to the design of retail bank service delivery systems:

1. Does the level of industrialization involved in the delivery of banking service contents vary from service content to service content?

2. Does the number of distinct delivery channels (span) available for the delivery of banking service contents vary from service content to service content?

3. Is the level of industrialization involved in the delivery of a service content related to the number of distinct delivery channels (span) through which this service content is available?

These research questions will be explored through a set of three hypotheses.

Hypothesis 1: Banking services differ in terms of which delivery channel receives primary emphasis. Thus, different banking service contents will show different industrialization scores[8] (IS).

Hypothesis 2: Banking services differ in the number of delivery channels (span) that are available for customers. Thus, different banking service contents will show different span scores[9] (SS).

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[7] Technology can be used not only to substitute for front-office labor but also to enhance its productivity (Roth and Van der Velde, 1988a). This later use of technology is not directly considered in the framework depicted in Exhibit 1.

[8] Industrialization score is an average measure of the industrialization level involved in the delivery of a number of related service contents that will be further explained in the following pages.

[9] Span score is a measure of the number of distinct delivery channels made available for the customer to interface with the service unit for the provision of particular service content.

Hypothesis 3: Banking services with intermediate industrialization scores (IS) will be delivered through a higher number of delivery channels (span) than banking services with either low or high industrialization scores. In other words, the relationship between IS and SS is convex.

The third hypothesis expresses the expected shape of the relationship between the two most critical service delivery system design variables.

Data and methods

Sample

This empirical investigation employs secondary data collected through a field study of a cross-sectional group of American retail banks. The retail banks' data were obtained from the 1987 Retail Banking Delivery System Survey administered jointly by Boston University School of Management and the Bank Administration Institute (BAI).[10] This section summarizes the research methodology of the project that is discussed at length elsewhere (Roth and Van der Velde, 1988a).

In relation to the sample design, Roth and Van der Velde (1988a) report that a probability sample of 1,244 retail banks was chosen from the FDIC Call Report tapes of approximately 16,000 commercial banks in the United States as of January, 1986. To maximize the chances of obtaining information on the forces that influence the design of delivery systems, the universe of banks was stratified into five groups by assets size: less than $100 million, $100-$499 million, $500-$999 million, $1-$3 billion, and over $3 billion. The objective of the sampling plan was to obtain an established minimum number of responses in each asset size category.

The overall response rate was slightly less than 10 percent, yielding 117 usable surveys. In view of the considerable length and complexity of the survey, this response rate is considered to be fair. The results are comparable with the response rates generally obtained in studies using similar populations. Roth and Van der Velde (1988a) report that the survey respondents are biased towards industry leaders, regardless of asset size.

For purposes of this paper a reduced sample of 90 banks was used in parts of the analysis due to problems of missing data. The reduced sample was found not to be statistically different from the full sample along any of the below dimensions (see Table 1); thus, there is no evidence that any bias was introduced by the exclusion of cases with missing data.

[10] Questions to explicitly test the research hypotheses of this paper were specifically designed and included in the questionnaire.

Table 1

Sample characteristics*

	Full sample (n=117)	Study Sample** (n=90)
Total assets		
- Assets greater than $1 billion	38	36
- Assets lower than $1 billion	62	64
Primary demographic market		
- Mass consumer market	29	30
- Middle consumer market	42	42
- Upscale and small business market	29	28
Primary geographical market		
- Local markets	76	79
- Not-local markets	24	21

* All figures are percentages.

** No deviation is significant at $p \leq 0.001$.

A questionnaire was mailed in March 1987 to top retail banking executives (typically, the retail unit's vice-president of operations) to capture information on the forces that influence the design of delivery systems. The questionnaire was modeled after the Manufacturing Futures Project Survey conducted annually since 1983 by Boston University, INSEAD and Waseda University. It was developed by the authors, and benefited from inputs from the Bank Administration Institute and other colleagues. It included multi-item instruments to measure the variables of interest for the research. The questionnaire has been pre-tested with banks from the Boston area to ensure completeness, relevance and feasibility.

The survey procedures included: advance notice letters announcing the survey to the sampled banks were sent two weeks before mailing the survey itself; two follow-up mailings at approximately two-week intervals followed by telephone calls to non respondents; manual coding and verification of all survey items;[11] and a review of the tabulations before data analysis to check for accuracy and consistency.

[11] In addition, each questionnaire underwent a computer consistency and edit check. All discrepancies and selected item nonrespondent on the surveys were followed up by mail and telephone calls to the respondent. All updates were applied to the final database. With respect to the data used in this study, variables were cross-checked with factual data such as current and projected dollar investment in technology, the importance of technology and other related questions.

Variables and Measures

In this section, the selection of variables and the development of measures to empirically test the three hypotheses are discussed. This will be followed by an explanation of how eight scales or primary groupings of banking services were derived. These scales will be used as the basis for empirically testing Hypotheses 1 through 3. The hypotheses test results will be described in detail in a following section.

The variables of interest in this paper are:

1. The industrialization score (IS).
2. The span score (SS) of banking service contents.
3. categories of typical banks service contents. There are no standard instruments for measuring these variables; this research represents a first attempt.

Eight delivery channels were selected for the research. They are intended to represent all the channels currently available in banks, and can be easily classified under the six categories of delivery channels contained in the general conceptual framework presented in Exhibit 1 (see Table 2). The eight channels are arranged in order of increasing level of industrialization, with the potential for efficiency increasing from first to last.[12] These channels are partly based on those suggested by Chase (1985) for service systems and those used by Chandler, Goodrich, and White (1984) in their study of retail banks.

Table 2

Correspondence between Delivery Channels Included in the Survey and the General Categories of Exhibit 1

Survey's Delivery Channels	General Categories
Personal visit to customer	Professional face-to-face
Platform officer	Professional face-to-face
Teller	Associate face-to-face
Person voice telephone	Person voice telephone
Mail	Mail/Courier
ATM and other on-premises self-service technology	On-premises self-service technology
Computer voice telephone	Remote self-service technology
Home banking	Remote self-service technology

Banking services industrialization scores (a measure of the industrialization levels used in their delivery) were determined on the basis of answers given to two questions. The first question involved a matrix of typical banking transactions and delivery channels. In the questionnaire, delivery channels are listed in columns[13] and banking service contents are listed in rows (see

[12] The fewer employee activities directly involved in the delivery activities, the higher the industrialization level.

[13] The questionnaire actually included nine channels that were reduced to eight for data analysis purposes. "ATMs" and "Other on-premises self-service technology" were lumped together in the same category; the reason being was that their industrialization levels were viewed as identical.

Appendix A.1). The respondents were asked to indicate the channel that is currently (1987) receiving the greatest emphasis, in terms of managerial attention and resources deployed for the bank's primary market. They were requested to do this for each of the 21 banking transactions listed in the matrix.

The second question sought similar data about the handling of customer inquiries related to banking products (see Appendix A.2). Respondents were asked to fill in a matrix containing the same delivery channels listed as columns, but this time with 15 banking information products as rows. Respondents were again asked to indicate their preferred channel for handling customer inquiries for their primary market.

For the purpose of data analysis, each of the eight delivery channels were assigned a numerical industrialization score ranging from "1" for the least industrialized (personal visit to customer) to "8" for the most highly industrialized (home banking); see Table 3 for a list of the eight delivery channels together with their numerical scores.

Table 3

Delivery Channels and their Numerical Scores

Delivery channel	Numerical Industrialization Delivery channel
Personal visit to customer	1
Platform officer	2
Teller	3
Person voice telephone	4
Mail/Courier	5
ATM and Other on-premises self-service technology	6
Computer voice telephone	7
Home banking	8

Banking Service Content Scales

Eight groups of retail banking services were analytically derived from the data by factor analysis. The expectation is that the industrialization score on any single banking service variable may be related to the industrialization score on some other banking service variable. If this is the case, then any particular bank's score on a set of related service content variables can be aligned with other variables of interest in this research.

To explore the expected grouping of variables, the statistical procedure of factor analysis was used so that differences among retail banks could be examined in terms of groups of banking service contents industrialization scores. Each of these groups or factors describes those sets of banking services that are nearly always clustered together. In this sense, each factor is descriptive of a banking service content construct which is represented by the interrelationships among constituent services. The industrialization scales are rotated so that each is independent of the other. In other words, a retail bank industrialization score (IS) in one factor is independent of its score in another.

To develop service content scales with respect to banking services industrialization scores, several principal component analyses were performed. Data were first divided into two subgroups, depending on whether the variables related to: 1) transactions, or 2) customer

inquiries. Then principal component analyses were carried out separately for each subgroup. This procedure was designed to reduce the sets of variables within each subgroup to a smaller number of mutually independent underlying factors. Principal component analysis produces descriptive matrices which aid in detecting underlying correlations. The procedure produced factors where the constituent service contents had similar industrialization patterns.

Principal component analyses were performed using inter-item Spearman correlation coefficient matrices. Data were initially factored using the principal axis method followed by a varimax rotation. The Kasier eigenvalue-one criterion (Rummel, 1970) was first employed to locate the possible cut-off range in the number of factors to be selected. The Scree test (Cattell, 1966) served as an auxiliary guide in the final selection of factors. In accordance with the above criteria, four factors were then derived from the original banking transaction variables.[14] Another four factors were derived from the original banking inquiries variables using the same procedures.

These factors were "cleaned" and converted into scales by eliminating those items which were found on examination to be "outliers" to the underlying construct, following the measurement approach of Churchill (1979). According to this procedure, items with low inter-item correlation were dropped from the instruments. Based on Nunnally (1978), internal consistency was assessed using alpha coefficient and item-to-total scale correlations. The subprogram "reliability" in the SPSSx software package was used to identify items of low inter-item correlation.[15] The Cronback alpha values ranged from 0.741 to 0.973, and all item-to-total correlations were positive and significant at p-levels less than 0.01. The alpha values were remarkably high for new instruments measuring complex constructs (Churchill, 1979).

These assessments provide adequate support for the reliability of the service content scales developed. Details of the various banking services indicators representing each service content scale and the assessment of reliability (Cronback alpha values) are provided in Appendix B. The development of these banking service scales allows testing the hypotheses with a reduced number of banking service variables. The scales can be considered a fair representation of the generic types of retail banking services, and as such, other banking services could possibly be ascribed as fitting in one of the service content scales.

Industrialization Score

Table 4 presents statistics describing the industrialization scores of each banking service scale developed earlier. As expected, there are differences among banking service scores. These will be discussed later in the context of the data analysis discussion related to Hypothesis 1.

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[14] For the first subgroup of 21 banking transactions three original variables ("Safety deposit access," "foreign currency" and "food stamps") were excluded from later analysis because they showed inconsistencies among the factors or were difficult to interpret due to double loadings.

[15] The transaction "application for credit cards" and the inquiries on "foreign currency" and "bill payments" were dropped in this stage of the analysis.

Table 4

Descriptive Statistics (Industrialization Score)

Service Content Scales	Means*	S.D.	Valid cases N
Depository transactions	3.301	.895	99
Applications for loans	2.167	.667	104
Bill payment transactions	3.818	1.093	101
Asset transactions	2.369	.888	98
Credit inquiries	2.617	.985	98
Asset inquiries	2.369	.888	98
Protection inquiries	2.589	.528	96
Account inquiries	2.895	1.005	95

*The mean of that distribution was 2.765, with a standard deviation of .552.

Span Score

The variable, "span score" (SS), was measured by means of the same two questions of the survey. For each of the 21 banking transactions and 15 customer inquiries, respondents were asked to place an "X" indicating which delivery channels the retail bank currently uses to handle the transaction or customer inquiry.

In this paper, a banking service content available through a higher number of delivery channels than another service content has a higher span score than a service content delivered through fewer channels. Coding the span scores was straightforward; the span score for each banking service was obtained by adding the number of delivery channels through which the banking service was provided. For example, if a respondent indicated that the channels currently available for the individual banking service "applications for credit cards" are "platform officer," "mail" and "telephone," a span score of "3" was assigned. Table 5 presents descriptive statistics for the span scores in each banking service scale.

Table 5

Descriptive Statistics (Span Score)

Service Content Scales	Means*	S.D.	Valid cases N
1. Depository transactions	3.061	1.098	115
2. Applications for loans	2.019	1.048	115
3. Bill payments transactions	2.635	.932	115
4. Asset transactions	2.119	.762	115
5. Credit inquiries	2.798	1.362	115
6. Asset inquiries	2.515	1.226	114
7. Protection inquiries	1.878	1.097	115
8. Account inquiries	3.404	1.345	115

*** The mean of that distribution was 2,554 with a standard deviation of .531.**

Data Analysis and Results

Hypothesis 1 stated that banking service contents differ in terms of which delivery channel receives primary emphasis. The Friedman test was used to test the significance of the overall mean industrialization ranks over the eight banking service content scales (Siegel, 1956; Hays, 1963). This test is useful whenever the measurement of the variable is at least an ordinal scale which is the postulated case for the industrialization score data. The Friedman test is used to determine the probability of whether the k-related samples could have come from the same population with respect to mean ranks. This nonparametric test has shown very favorable results when compared with the most powerful parametric test, the F-test. The null hypothesis states that each of the banking service scales is drawn from the same population. On the other hand, if banks tend to emphasize different delivery channels for one or more of their service contents (i.e., if H1 is false), then the rank totals should vary statistically from one banking service content scale to another.

Table 6

Friedman Test Results on Industrialization Mean Ranks

Service Content Scales	Mean Industrialization Rank
1. Depository transactions	6.31
2. Applications for loans	2.57
3. Bill payments transactions	7.27
4. Asset transactions	3.32
5. Credit inquiries	3.99
6. Asset inquiries	2.86
7. Protection inquiries	4.51
8. Account inquiries	5.19

*N=90, df=7 CHI.SQUARE: 292.7 (P<0.000)

On the basis of the results of the test shown in Table 6, the null hypothesis of identical distributions for industrialization scores over the 8 scales of banking services was rejected at the .05 level of significance. Possible reasons for the rejection may be explained by means of post hoc comparison on contrasts involving the ranked values. The post hoc procedures for the Friedman test (Marascuilo and McSweeney, 1977) are the chi-square analog to Scheffe's test. These procedures allowed us to make pair-wise comparisons of ranked means. For our data, any difference in ranks exceeding 1.019 would represent a significant difference at the 95 percent confidence level.

Table 7

Post-hoc Comparisons for the Industrialization
Mean Ranks Differences over Service Content Scales

		Service Content Scale						
Service Content Scales	**Mean rank**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Applications for loans	2.57	.29	.75	1.42*	1.94*	2.62*	3.74*	4.70*
2. Asset inquiries	2.86		.46	1.13*	1.65*	2.33*	3.45*	4.41*
3. Asset transactions	3.32			.67	1.19*	1.87*	2.99*	3.95*
4. Credit inquiries	3.99				.52	1.20*	2.32*	3.28*
5. Protection inquiries	4.51					.68	1.80*	2.76*
6. Account inquiries	5.19						1.12*	2.08*
7. Depository transactions	6.31							.96
8. Bill payment transactions	7.27							

*p≤0.05.

The ordered mean rank values and their differences are given in Table 7 with an indication of those considered statistically significant. These results illustrate that the level of industrialization involved in the delivery of banking services is lowest in the areas of loan applications and asset inquiries and that transactions, and their industrialization scores are statistically similar to each other. At the same time, it becomes clear for this sample that the highest level of industrialization occurs in the areas of bill payments and depository transactions. That comes at no surprise since both scales represent fairly routine, easy-to-standardize banking services.

Table 7 indicates that three classes of banking service contents with statistically similar industrialization patterns exist in our data. The first group comprises *applications for loans, asset inquiries* and *asset transactions* which in light of the matrix shown in Exhibit 1 are classified in the category "low standardization potential." Note that these banking services are highly complex, not routine-type transactions and the average customer is not well acquainted with them. The second group contains three more service contents all of which are inquiries: *credit, protection* and *accounts inquiries*. Since their scores fell between the other two groups, these banking services may be representative of the category "medium standardization potential." Third, depository and *bill payment transactions* are assigned to the "high standardization potential" group, characterized by a high level of customer knowledge and a low level of content complexity. As before, it should be noted that depository and bill payment transactions are among the most routine banking services.

A similar procedure was carried out for testing Hypothesis 2. A parametric F-test was used to test for significance among the means of the span scores of the various banking service contents scales. Specifically, a one-factor ANOVA with repeated measures (Winer, 1971) was used to test for significantly different span scores among the banking services. For analytical purposes, each banking service scale was assigned a span score ranging from "1" (where only one delivery channel is available for each individual service content comprising the particular scale) to "8" (when all eight delivery channels are available for each service content in the scale). The null hypothesis states that the average span score for each service content scale are equal. The null hypothesis is rejected if the average scale score on one or more service scales varies.

Table 8 reflects the ANOVA results indicating that the banking service contents differ in the number of channels that are available for the delivery of the service (F=45.27, p<.000). The results, therefore, support rejection of the null hypothesis in favor of the alternative hypothesis that at least one banking scale differs from another in the average number of delivery channels available.[16]

Table 8

ANOVA Results on Mean Span Scores

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Between subjects	113	579.468	5.128	5.172	0001
Within subjects	798	791.266	.992		
treatments	7	226.311	32.33	45.266	.0001
residual	791	564.955	.714		
Total	911	1370.734			

Since it is important to locate the specific differences among the span scores over the banking services scales, the Scheffé post-hoc multiple-comparisons procedure was also used. Table 9 shows the Scheffé analysis results for the span scores.

Table 9

Post-hoc Comparisons for Span Scores Over Service Content Scales Using the Scheffé Procedure

		Service Content Scale						
Service Content Scale	**Mean**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Protection inquiries	1.88	.21	.54	4.57*	6.26*	9.40*	15.54*	26.56*
2. Applications for loans	2.10		.77	2.83*	4.20*	6.82*	12.17*	22.09*
3. Asset transactions	2.12			1.98	3.14*	5.45*	10.31*	19.56*
4. Asset inquiries	2.52				.13	.86	3.26*	9.10*
5. Bill payments transactions	2.64					.32	2.07*	7.03*
6. Credit inquiries	2.80						.77	4.36*
7. Depository transactions	3.10							1.47
8. Bill payment transactions	3.40							

*p<.05.

The results of Table 9 are different, and are not as clean as the ones on Table 7. Although there are no clear-cut groups, the three banking services with the lower span scores, and therefore, with the highest specialization in terms of distribution channels, are *protection inquiries, applications for loans* and *asset transactions.* This seems logical, since these banking services are relatively complex, low in volume, and therefore will probably require some specialization in the delivery channel.

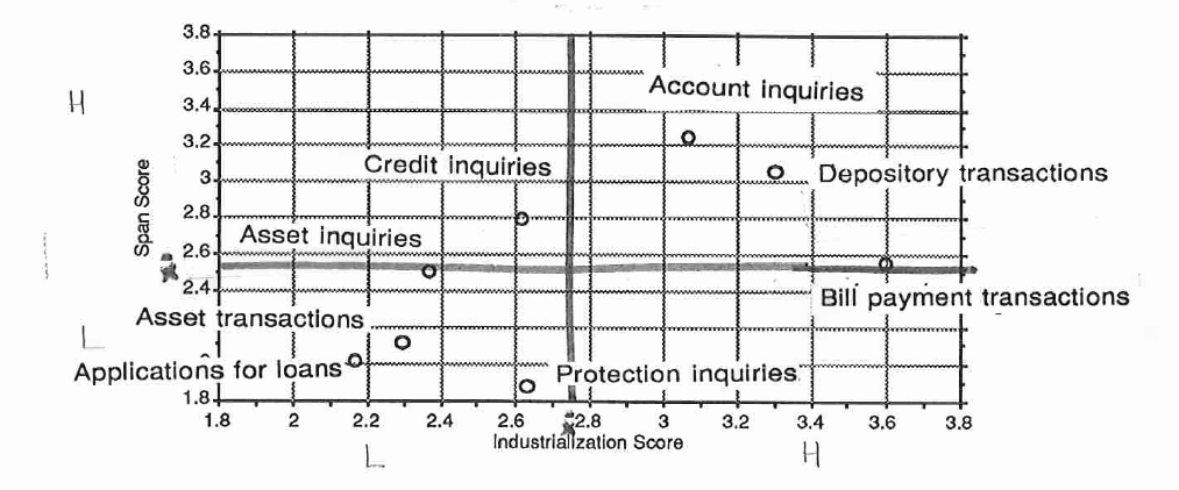
[16] The F-test for banks as source of variance is also statistically significance (F=5.17, p<.00). This means that banks differ in the number of delivery channels that made available for the banking service scales.

Conversely, *account inquiries* and depository *transactions* are the banking services for which banks offered the widest range of distribution channels. It seems that retail banks are particularly interested in providing, for customer convenience, a wide choice of contact channels for account inquiries and depository transactions, thus enabling their customers to find a distribution modality to match their needs. Table 9 also shows that account inquiries have a much greater range of delivery channels than do *protection inquiries*, while there are surprising similarities among the span scores of *credit inquiries*, asset inquiries and bill payment transactions.

Finally, we consider the relationship between the mean industrialization scores and the mean span scores over each service content scale. A scattergram of industrialization and span values of banking services scale variables is presented in Figure 1. Using the average industrialization score (2.75) and the average span score (2.52) as criteria for establishing two categories of scores ("high" = "above the mean" and "low" = "below the mean"), most of the scales fall either in the low/low or high/high quadrant. The only exception is "credit inquiries" which belongs to the low industrialization/high span quadrant.

Figure 1*

Scattergram of Banking Service Content Scales by Mean Span and Industrialization Scores



*Each plotted point is the average pair of scores for one service content scale variable.

It is interesting to note that no service content falls in the high industrialization/low span quadrant. This quadrant is hypothesized to be the most efficient from a design point of view. Service contents within this quadrant would be available through few delivery channels. Furthermore, the channel most emphasized would be highly industrialized.

Figure 1 suggests a convex relationship between the span score of banking services and their industrialization scores. This shape vaguely resembles the shape of product life cycles. Similarly, although the evidence is not conclusive, this shape hints at the possibility of a *service*

delivery system design life cycle. A service delivery system design life cycle may be a tool to describe the evolution of retail banking delivery system design over time[17].

Hypothesis 3 was examined with both the Kendall (.429) and Spearman (.571) rank order concordance coefficients to determine whether the industrialization and span values of the banking service scale variables were related. These measures of association showed a significant relationship. To provide a better fit with the curvilinear relationship hypothesized, two terms of a multiple regression equation were also used to approximate the effect of industrialization on span. The result (adj. R-squared = .346) offers some evidence for the existence of the hypothesized curvilinear relationship. However, the evidence is weak since several banking service scales were not significantly different from each other on their industrialization scores. The previous finding provides weak evidence in support of Hypothesis 3.

Conclusions and Limitations

This paper represents an effort to provide empirical support for a conceptual framework (Huete, 1987) which may have wide applications for the design of service encounter systems. The basic assumptions of the matrix were supported for two of three hypotheses. The evidence for the third hypothesis is weaker. One of the major contributions of this paper is the validation of the conceptual framework, which supports the proposed linkages between delivery channels and banking service contents.

Eight broad scales or primary groupings of banking service contents were empirically derived. These scales are reasonable representations of typical retail banking services. Among the eight service scales, three categories of general banking services which had statistically similar industrialization scores were found. The first group is comprised of *applications for loans, asset inquiries and asset transactions*. Since these banking services are complex, the average customer is not well acquainted with them. They represent service contents with "low standardization potential." The next group contained three banking services all of which are customer inquiries including *credit, protection and accounts* inquiries. Finally, depository and bill payment transactions formed a third group which was assigned to the "high standardization potential" category. These services are characterized by a high level of customer knowledge and a low level of content complexity.

Banking services content scales had different scores along the industrialization and span dimension, implying that industrialized delivery channels and a wider choice of customer contact channels are better suited to some types of banking services than to others. The results also hinted that a convex-curve relationship between the two key factors in delivery system design — industrialization and span — exists. This relationship vaguely resembles the shape of product life cycles. From this we hypothesized for future research that a similar phenomenon,

[17] Historically, banking services were primarily delivered through only a few channels and with no emphasis on industrialization. Now we observe service encounter designs in which both industrialization and span are increased. That is, retail banks continue to make available the traditional, less industrialized, high-contact delivery channels at the same time as introducing more highly industrialized delivery channels. If such a delivery system design exists, then we hypothesize that in the future an even greater emphasis will be placed on industrialization and a reduction in delivery channels will also occur. It would be reasonable to expect that the next stage might be a further industrialization increase and span reduction. This will make a banking service fall in the high industrialization-low span quadrangle that currently was found empty.

the delivery system design life cycle, may be found. The data suggest that banking services with low standardization potential would have a smaller "natural area" than banking services with medium standardization potential as proposed in the conceptual framework.

As a guide to future empirical research, it is necessary to examine some of the key limitations of this study. Perhaps the most obvious limitation is that the data are based on managers' perceptions, and therefore liable to subjective error. Although we believe that the results of the reliability test lend substantial credibility to our results, similar studies using objective measurements should be undertaken to test the findings. Another limitation of this study is that the data give only a cross-sectional "snapshot" picture of the banks represented. Long term, longitudinal studies (which is the aim of the overall Financial Future Project[18]) would be a more appropriate tool for the examination of specific causal linkages and their implications in non-financial performance measures.

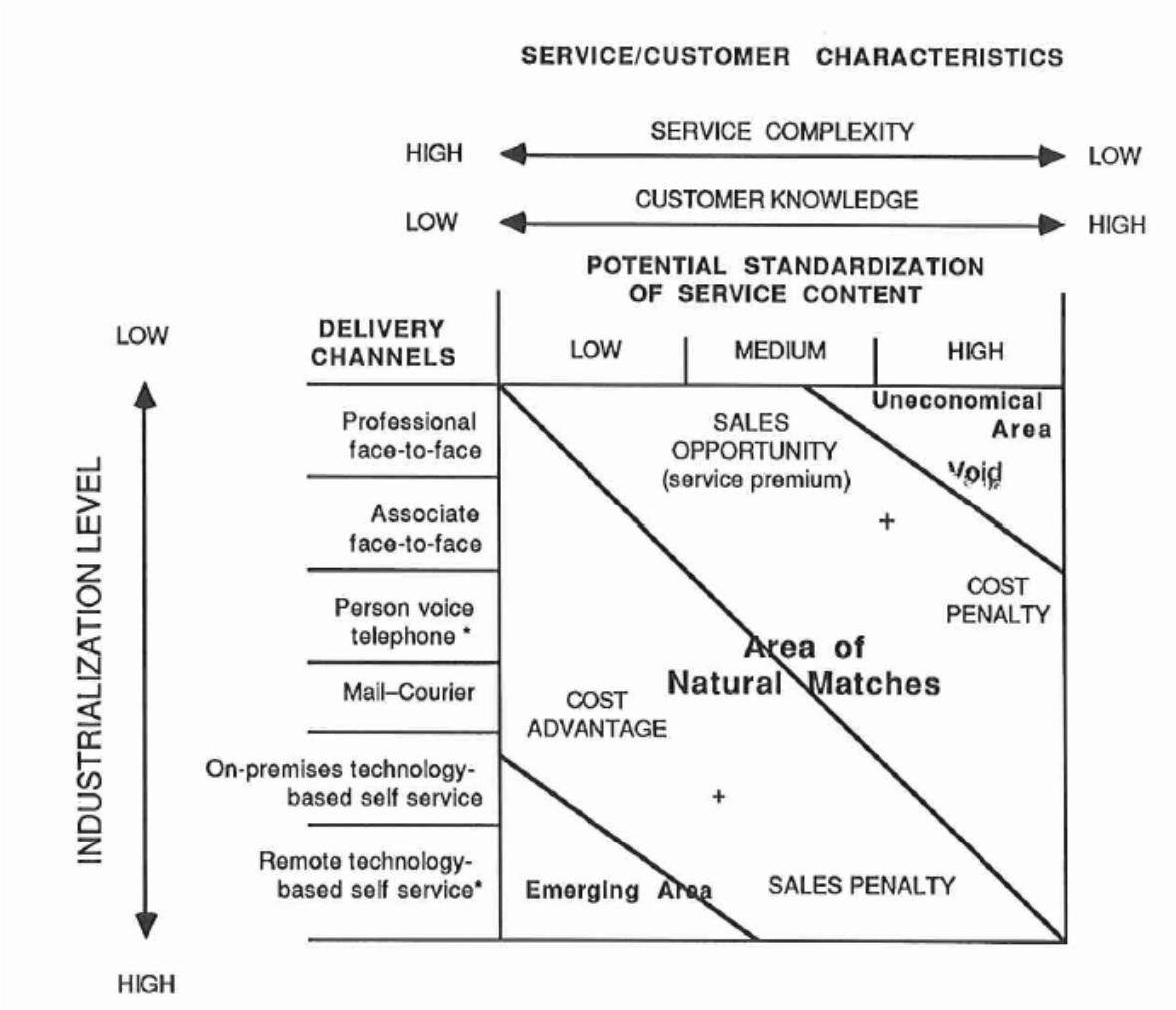
Methodology aside, our study is also restricted by several substantive limitations. We treat industrialization solely in terms of the delivery option receiving primary emphasis for the bank's primary market. However, industrialization is a more complex phenomenon. To fully understand the implications and the context of such a phenomenon, it would be necessary to take into consideration, for each service content, the percentage of the service delivered by each available delivery option.

Finally, this study has focused on only a few of the mechanisms available to service executives for designing service encounters. Other administrative mechanisms that future research might usefully examine include design of backroom and front-office interface, design of service contents delivered through industrialized channels, design of management information systems, use of automation which enhances the productivity of front-office personnel, and human resource policies used for the shift from one delivery system design approach to another.

[18] See Roth and Van der Velde, 1988.

Exhibit 1

A Matrix for Linking Service Contents with Delivery Channels



*Only handles information and not physical "goods". May not be a viable option for certain services involving the transaction of physical goods.

Appendix A

Excerpts from the Questionnaire

A.1. Banking Transactions

12. Listed below is a retail banking unit's transactions/means of customer interface matrix. The matrix depicts the means by which the customers can interface with the bank to execute particular transactions. Please address the following three questions for each row in the matrix:

    - Place an "x" by each means of interface your retail banking unit currently offers to its customers to execute transactions named in the row.
    - Place on "7" (1987) in each row to indicate the currently most emphasized (in terms of managerial attention and resources deployed) means of interface to execute the transactions for your *primary* market.
    - Place one "0" (1990) in each row to indicate the planned most emphasized (in terms of managerial attention and resources deployed) means of interface to execute the transactions for your target market.

Means of customer interface for the execution of transaction

	Personal Visit to Customer	*Platform Officer*	*Teller*	*Person Voice Telephone*	*Mail*	*ATM*	*Other On-premise Self-service Technology*	*Computer Voice Tele-phone*	*Home Banking*
BANKING TRANSACTIONS									
Applications (opening and closing of accounts)									
Deposit accounts	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Credit cards	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Installment loans	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Home equity loans	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Home mortgages	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Discount brokerage	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Club accounts	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Withdrawals									
Clecking (regular, NOW)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Savings	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Deposits									
Checking (regular, NOW)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Savings	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Credit									
Cash advance	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Payments									
To the bank	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
To third parties (utilities)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
To third parties (other bills)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other									
Financial planning	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Safety deposit access	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Securities	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Trust management	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Food stamps	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Foreign currency	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
CHECK IF THE MEANS IS NOT CURRENTLY AVAILABLE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

A.2. Customer Inquiries

13. Listed below is a retail banking product/means of handling customer inquires. The matrix depicts the means by which the retail banking unit provides information in response to customer inquires. Please address the following three questions for each row:

    - Place an "x" by each means of interface your retail banking unit currently uses to handle customer inquires related to the product named in the row.
    - Place on "7" (1987) in each row to indicate the *currently most emphasized* (in terms of managerial attention and resources deployed) means of interface to execute the transactions for your primary market.
    - Place one "0" (1990) in each row to indicate the planned most emphasized (in terms of managerial attention and resources deployed) means of interface to execute the transactions for your target market.

Means of customer interface for the execution of transaction

	Personal Visit to Customer	*Platform Officer*	*Teller*	*Person Voice Telephone*	*Mail*	*ATM*	*Other On-premise Self-service Technology*	*Computer Voice Tele-phone*	*Home Banking*
PRODUCT FAMILY									
Transactions Products									
Deposit accounts	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Bill payment services	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Credit Products	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Credit cards	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Installment loans	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Home equity loans	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Home mortgage	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Educational loans	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Personal credit lines	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Assets Products									
Money market funds	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Securities brokerage	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
IRAs, Keogh account									
Trust management	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other Products									
Traveler's checks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Credit life insurance	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Foreign currency	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
CHECK IF THE MEANS IS NOT CURRENTLY AVAILABLE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Appendix B

Banking Services Scales and Included Items[19]

Banking Transactions

1. Depository transactions (0.973)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- withdrawals of checking accounts
- withdrawals of savings accounts
- deposits of checking accounts
- deposits of savings accounts
- cash advances

2. Applications for loans (0.867)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- applications for installment loans
- applications for home equity loans
- applications for home mortgages

3. Bill payments (0.741)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- payments to the bank
- payments to third parties (utilities)
- payments to third parties (other bills)

4. Asset transactions (0.800)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- applications for deposit accounts
- applications for discount brokerage
- applications for club accounts
- financial planning
- securities
- trust management

[19] Figures in parentheses are the reliability coefficients (Cronbach's alpha) for the respective constructs.

Appendix B (continued)

Banking Inquiries

5. Credit inquiries (0.924)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- inquiries on credit cards
- inquiries on installment loans
- inquiries on home equity loans
- inquiries on home mortgage
- inquiries on educational loans
- inquiries on personal credit lines

6. Asset inquiries (0.775)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- inquiries on securities brokerage
- inquiries on IRAs and Keogh accounts
- inquiries on trust management

7. Protection inquiries (0.893)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- inquiries on traveler's checks
- inquiries on credit life insurance

8. Account inquiries (0.808)

Operationalized by using an eight-point scale referring to the delivery option (ranging from personal visit to customer to home banking) currently most emphasized for the following items:

- inquiries on deposit accounts
- inquiries on money market funds

References

Bleyleben, P.R. and T.S. Wurster (1985), "Changes in Retail Banking," *Bankers Monthly*, April 15, pp. 9-11.

Carlzon, J. (1986), "Moments of Truth," Cambridge, MA: Ballinger.

Cattell, R.B (1966), "The Scree Test for the Number of Factors," *Multivariate Behavioral Research*, 1:2, pp. 45-76

Cohen, B.R. (1987), "Taking the Customer out of the Branch," The Bankers Magazine, May-June, pp. 57-59.

Czepiel, J.A., M.R. Salomon, and C.F. Surprenant (1985), "The Service Encounter: Managing Employee/Customer Interaction in Service Businesses," Lexington, MA: Lexington Books.

Chandler, G.D., J.W. Goodrich, and D.E. White (1984), "Developing Winning Distribution Strategies," *The Bankers Magazine*, Nov.-Dec., pp. 30-40.

Chase, R.B. (1978), "Where Does the Customer Fit in as Service Operation?," *Harvard Business Review*, Nov.-Dec., pp. 137-142.

Chase, R.B. (1980), "A Classification and Evaluation of Research in Operations Management," *Journal of Operations Management*, 1:1, pp. 7-14.

Chase, R.B. (1981), "The Customer Contact Approach to Services: Theoretical Bases and Practical Expansions," *Operations Research*, 29, pp. 698-706.

Chase, R.B. (1985), "A Matrix for Linking Marketing and Production Variables in Service System Design," *Decision Science Institute Conference Proceedings*, Las Vegas.

Chase, R.B. (1986), "Managing the Sales/Efficiency Trade-Off in Services," Graduate School of Business Administration, University of Southern California Working Paper.

Chase, R.B., G.B. Northcraft, and G. Wolf (1984), "Designing High-Contact Service Systems: Application to Branches of a Savings and Loan," *Decision Sciences*, 15, pp. 542-555.

Churchill, G.A. (1979), "A Paradigm for Developing Better Measures of Marketing Constructs," *Journal of Marketing Research*, February, pp. 64-73.

Davis, S. (1987), "Future Perfect," Cambridge, Ma: Ballinger.

Fitzsimmons, J.A. (1985), "Consumer Participation and Productivity in Service Operations," Interfaces, May-June. pp. 60-67.

Friars, E.M., W.T., Gregor, and M.L. Reid (1985), "Distribution: The New Competitive Weapon," *The Bankers Magazine*, May-June, pp. 45-52.

Greenberg, B.A. and L. Harris (1987), "Consumer Banking in the United States," *The Service Delivery Gap*, New York, NY: The Economist Publications.

Hayes, R.H. and S.C. Wheelwright (1979a), "Link Manufacturing Process and Product Life Cycles," *Harvard Business Review*, pp. 133-140.

Hayes, R.H., and S.C. Wheelwright (1979), "The Dynamics of Product-Process Life Cycles," *Harvard Business Review*, Mar.-April, pp. 127-136.

Hays, W.L (1963), "Statistics". New York: Holt, Rinehart and Winston.

Huete, L.M. (1987), "A Matrix for Linking Service Contents with Delivery Options," *Decision Science Institute Conference Proceedings*, Boston.

Huete, L.M. (1988), "Delivery System Design in American Retail Banking: An Empirical Study," Unpublished Thesis. Boston University School of Management.

Levitt, T. (1972), "The Production Line Approach to Service," **Harvard Business Review**, Sept.-Oct., pp. 41-52.

Levitt, T. (1976), "The Industrialization of Services," *Harvard Business Review*, Sept.-Oct., pp. 63-74.

Lovelock, C.H. and R.F. Young (1979), "Look to Customers to Increase Productivity," *Harvard Business Review*, May-June, pp. 168-178.

Mabert, V.A. (1982) "Service Operations Management: Research and Application," *Journal of Operations Management*, 2, pp. 203-209.

Marascuilo, F.A. and M. McSweeney (1977), "Nonparametric and Distribution-Free Methods for the Social Sciences," Monterey, CA: Brooks Cole.

Miller, J.G. and M.B.W. Graham (1981), "Production/Operations Management: Agenda for the '80's," *Decision Sciences*, 12, pp. 547-571.

Nunnally, J. C. (1967), "Psychometric Theory," New York: *McGraw-Hill*.

Roth, A.V. and M. Van Der Velde, (1988a), "The Future of Retail Banking Delivery Systems," Rolling Meadows, Ill: Bank Administration Institute, 1988.

Roth, A.V. and M. Van Der Velde, (1988b), "The Strategic Role of Operations in Retail Banking Delivery Systems," Boston University Working Paper Series.

Rummel, R.J. (1970), "Applied Factor Analysis," Evanston, IL: Northwestern University Press.

Scheffe, H. (1959), "The Analysis of Variance," New York:John Wiley & Sons..

Siegel, S. (1956), "Nonparametric Statistics for the Behavioral Sciences," New York: McGraw-Hill.

Skinner, W. (1974), "Manufacturing: The Missing Link in Corporate Strategy," *Harvard Business Review*, May-June, pp. 113-121.

Skinner, W. (1974), "The Focused Factory," *Harvard Business Review*, May-June, pp. 113-121.

Sullivan, R.S. (1982), "The Service Sector: Challenges and Implications for Research in Operations Management," *Journal of Operations Management*, Vol. 2, pp. 211-214.

Van Der Veld, E. M. and A.V. Roth (1988), "The Role of Technology in Retail Banking Delivery Systems," Bank Administration (forthcoming).

Winer, B.J. (1962), "Statistical Principles in Experimental Design," New York: McGraw-Hill.