Understanding consumer choice in the hospitality and tourism industry: An electrical engineering control system approach

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Abstract

In this conceptual paper, we show how an electrical engineering control system may be used to help explain consumer choice behavior in the hospitality and tourism industry. Key concepts of electrical engineering control systems are explained as they might apply to simple (refrigerator thermostat) and complex multidimensional (aircraft autopilot systems) control systems. This understanding is used to understand consumer choice behavior in the industry. For example, we might consider the reference signal to be a person's set of desired attributes in a hotel. We sense the environment through our usual five senses enhanced, in today's world through technology, which, if not an exact match with our desires, creates an error or a dissonance, which may lead to some corrective action like choosing a different tourism alternative. This change leads to a modified input through our sensors, and then a modified comparator signal. If the error is zero or within acceptable limits, we are satisfied and are not motivated to change any more. If not, we continuously adjust our actions until we are reasonably satisfied.

It is quite common for a hotel to ask for ratings on a set of predetermined factors. This paper does not deny the value of such an exercise, but posits that such ratings are not sufficient to get a complete picture. Rather, we need to determine the appropriate reference, sensor, and error signals. The reference signal is the set of desired attributes. The sensor signal might reasonably be reflected in the ratings on the typical rating form that the customer completes at the end of the experience. The error signal is the discrepancy between the reference signal and the sensor signal – and the control system model proposes that it is that discrepancy or error signal which will be the primary driver of the action signal.

1) Introduction

In this conceptual paper, we show how an electrical engineering control system model may be used to help explain consumer choice behavior in the hospitality and tourism industry.

Let us first better understand an electrical engineering control system. A very simple form of a control system is the heating and cooling system in a car. The user sets a desired temperature. The system monitors the actual temperature, compares it with the desired temperature, and then decides what action to take – turn on the heater, turn on the air-conditioner, or do nothing. In any case, the monitoring continues and at some later time, the same decision process occurs. The net result of this control system is to keep the temperature as close to the desired level as possible, probably within a few degrees here or there.

Now, let us introduce some engineering terminology. The desired temperature is what an engineer might call a *reference signal*. A reference signal is set from outside of the system – meaning, it is imposed from outside the immediate system being studied – and is not the result of anything your car heating/cooling system does. In the extension to human behavior, the reference signal may simply be the result of a higher order level of self-imposed values or beliefs; this concept will be explored later in the paper.

There is the *sensor*, which senses the *input* from the outside environment. A *comparator* is what compares the two – the desired and the actual temperature. That comparison generates what is called an *error signal* – which may be a simple mathematical function like one minus the other, or a more complex non-linear one. The error signal then goes through a *control function* which in turn drives an *action signal* which may turn on the air-conditioner or the heater. That changes the environment, which causes the input signal to change, which is then monitored by the sensor. And, so the loop is complete.

This is an example of just a unidimensional signal – it is monitoring and changing only one variable – temperature. A more complex control system like an aircraft's autopilot system continuously monitors and changes a multidimensional signal: speed, altitude, attitude, etc.

To bring this model to bear on consumer choice behavior in the hospitality and tourism industry, we might consider the reference signal to be a person's set of desired attributes in a product. In this case, these desired attributes are typically the result of a higher order reference signal such as self-imposed values or beliefs. We sense the environment through our usual five senses enhanced, in today's world through technology, which, if not an exact match with our desires, creates an error or a dissonance, which may lead to some corrective action like choosing a different tourism location or alternative. This change leads to a modified input through our sensors, and then a modified comparator signal. If the error is zero or within acceptable limits, we are satisfied and are not motivated to change any more. If not, we continuously adjust our actions until we are reasonably satisfied.

It is quite common for units in the hospitality or tourism industry to ask a customer (after the purchase experience) to rate the unit or entity on a set of predetermined factors. It is believed that these ratings lead to self-improvement of the entity, which leads to re-purchase behavior or loyalty on the part of the customer. The conceptual approach proposed in this paper does not deny the value of such an exercise, but posits that such ratings are not sufficient to get a complete picture of the customer's thinking. The control system approach or model would suggest that simply asking a (potential) consumer to rate a hospitality or tourism location or option will not suffice in understanding or predicting behavior. For a more complete understanding, we need to determine the appropriate reference, sensor, and error signals. The reference signal is the set of desired attributes. The sensor signal might reasonably be reflected in the ratings on the typical rating form that the customer completes at the end of the experience, because that is what s/he perceives the experience to be. The error signal is the discrepancy between the reference signal and the sensor signal – and the control system model proposes that it is that discrepancy or error signal which will be the primary driver of the action signal, i.e. post-purchase satisfaction and behavior such as re-purchase behavior or loyalty on the part of the customer.

2) Literature review

Unsurprisingly, because of the innovative nature of this application of electrical engineering control systems to the hospitality and tourism industry, there has not been much research published in this area. In fact, there are very few references to the use of electrical engineering control systems in the study of human behavior. And, even at a stretch, these are, in the main, anchored in the literature of psychology and social psychology, and are very dated. Nonetheless, and with the caveats mentioned above, they are relevant to this approach and are reported here.

The concept of a control system, however, is not restricted to electrical engineering. As far back as the early 1980s, there were several studies done in the psychology and social psychology literature that referred to the reference value, and the inclination of the individual to modify behavior or actions that move them closer to that reference value or avoid actions that would move them further away from the reference value (Carver and Scheier, 1982, 1990, 1998; Higgins, 1987, 1989a, 1989b).

Two references by the same author that go even further back than the aforementioned studies specifically use electrical engineering concepts to study human behavior. Sethna (1977) reports on the use of an electrical engineering control system approach in refining multi-attribute attitude models to better explain consumer behavior. Significant improvements in R^2 result by using the error signal construct. Sethna (1978) demonstrates how an electrical circuit analogue could explain market behavior, and tied that to the timing of advertising. While the 1978 paper uses electrical circuits, however, it is not strictly speaking a control system approach, in that concepts of a reference signal and error signal are not a significant part of the paper.

Without using electrical engineering control systems, Boldero and Francis (2002) refer to similar concepts in psychology and social psychology literature. They distinguish between using a reference as a goal and a standard: "When a reference value functions as a standard, it represents the desired state for the self in the present. As a result, a discrepancy between the current self and the reference value represents a negative psychological state. Consequently, when this discrepancy becomes accessible negative emotions are experienced, the intensity of which is related to the magnitude of the discrepancy. These emotions motivate attempts to reduce this discrepancy. … In contrast, when a reference value functions as a goal, it represents 'a future consequence … that is desirable to the individual who seeks to obtain it.'"

Consistent with the finding by Sethna (1977) that the use of the error signal leads to better empirical results, in a study of 23 university students in an introductory Army ROTC program, Reich and Rosenberg (2004) found that "self-discrepancy" (which is a similar concept as the error signal) best predicted ROTC cadets' intention to continue in their program.

Lewin, Dembo, Festinger, and Sears (1944) have provided a rather thorough treatment of Level of Aspiration Theory. For convenience of discussion, they have considered a simple example of a person shooting at a target. He "has scored 6 in shooting at the target with ring 10 in the center. He decides the next time to try for 8. He attains 5, is disappointed, and decides next time to try for 6 once more." In the context of this example, Lewin *et al* distinguish the following main points on an advancing time scale:

1. "The past performance … ('he has scored 6').
2. Setting of the level of aspiration … ("try for 8").
3. The execution of action, e.g., the new performance ('attains 5').
4. The reaction to the level of attainment, such as feeling of success or failure ('disappointment'), leaving the activity altogether, or continuing with the new level of aspiration ('try again for 6')." Lewin et al define the "ideal goal" in this context as a desire to hit center. However, he may set an "action goal" as 6 because 10 is too difficult. They state that "setting the action goal as 6 in the second trial does not mean that the individual has given up his ideal goal. … the action goal is a part of the entire goal structure of the individual." Further, Lewin et al define "attainment discrepancy" as the difference between the level of aspiration and the level of performance (called "attainment discrepancy"). They state that the direction and size of the attainment discrepancy are two of the major factors for the psychological feeling of success or failure."

Here, we can draw parallels between the work of Lewin *et al* and the present piece of research. The discussion on the functioning of the control system and the description of the Reference Signal shows how a difference between the reference signal ("level of aspiration") and the perception of an event or an object such as a hotel or a venue ("level of performance") leads to an error signal ("attainment discrepancy"), which in turn leads to feelings of satisfaction ("success") or dissatisfaction ("failure") which further effects future actions or behavior. Lewin et al discuss the problem of determining the level of aspiration and the ideal goal, pointing out that the verbal expression is the best method, though imperfect. Festinger's (1942) and Jucknat's (1937) analyses of experimental data show that the stronger the success, the greater is the percentage of raising the level of aspiration, and the stronger the failure, the greater the percentage of lowering the level of aspiration. These findings are consistent with the hypothesis that the individual finds a large error signal ("attainment discrepancy") uncomfortable, and if future performance or brand trials fail to match up to the reference signal, the individual may modify the latter.

Siegel (1957) has discussed the role of a person's level of aspiration in decision-making and the integration of level of aspiration theory with decision theory. He proposes that, if various alternatives are available to an individual, s/he will choose from among those alternatives, towards each of which s/he has a subjective probability of attainment (P_i) and a utility (U_i) so as to maximize subjective expected utility, SEU. That is, the individual will choose so as to

"Maximize SEU = $\sum_i \; Pi * Ui$"

where Ui is a function of the level of aspiration, and consistent with Festinger's work, will attempt to seek success and avoid failure. The control-systems approach of this piece of research yields a decision rule which is similar to that given above. It hypothesizes that, if various brands are available to a consumer, s/he will choose from those brands so as to minimize the Error Signal, where the Error Signal = f (Reference Signal, Perception, Satisfaction).

However, in one sense, the control system model assumes a satisficing rather than a maximizing consumer, in that the individual chooses that brand or hotel or venue which generates an acceptably low error. Below this low "threshold" level, the actual magnitude of the error signal may or may not be a significant factor in brand choice.

The satisficing assumption of people is the one used by Starbuck (1963) in his work on Level of Aspiration Theory and Economic Behavior. Thus, Level of Aspiration Theory can be integrated into the framework of the control-systems model and can provide not only a useful theoretical backing to this work, but can also provide some pointers for practical applications, such as the personality factor findings in segmentation strategy.

3) Explanation of the model

Background

A widely accepted and commonly used model of Behavior, both in the Psychological and Marketing literature, is the simple input-output model. The model proposed here is an Electrical Engineering Control System model incorporating feedback effects and a comparator function.

It is proposed that this control system model has utility in explaining already known behavioral phenomena, and can provide a better explanation of these effects. The model that has been widely used to explain behavior is shown in Figure 1.

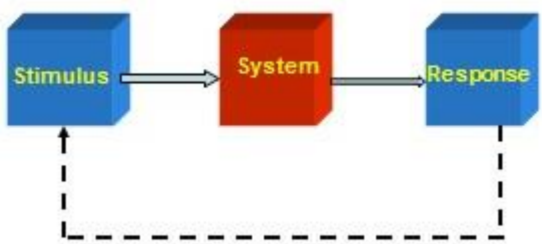

Figure 1: The Stimulus-Response with Feedback Model

The closed-loop concept, which this model theorizes, treats behavior as part of the cause of that same behavior so that cause and effect can be traced all the way around a closed loop. When any phenomenon in this closed loop persists in time, cause and effect lose their distinctness and one must treat the closed loop as a whole rather than sequentially. This is where feedback enters the picture. All behavior involves feedback whether it is a spinal reflex or self-actualization. If we neglect it, we are neglecting a very fundamental aspect of behavior. This is why it is tremendously important in our understanding of behavior to consider it explicitly.

An electrical engineering control system model

Let us consider a closed-loop representation of behavior of other more complex forms than that of Figure 1. Such a model is shown simply in Figure 2, which introduces the important concept of a Reference Signal which provides the reference frame by which the stimulus is judged.

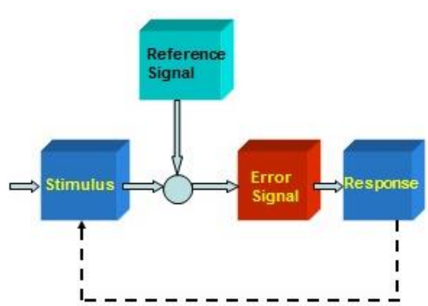

Figure 2: A Simple Control System Model

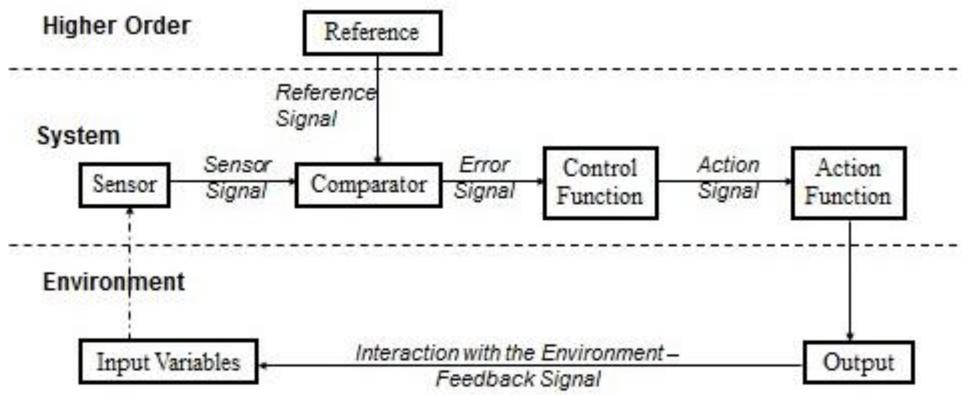

Figure 3: A More Sophisticated Control System Model

Let us now consider how this works. The Sensor in the system (eyes, ears, hands, etc.) senses the environmental physical variables or Input (this may be heat or cold, a product on a supermarket shelf, or the atmosphere in a hotel room or on a cruise ship). This physical information is conveyed to the internal processing system which gives rise to a Sensor Signal inside the system, which is an internal analog of the external state of affairs. This step may be instantaneous without a conscious effort to structure it or think about it. The internal variables get organized into some function which is the system's perception of it. This Sensor Signal is compared with a Reference Signal, which is a set of desired attributes.

The discrepancy is noted in the form of an Error Signal which activates the Control Function (another conscious or unconscious thinking process by which the system decides what to do about the Error Signal). This activates the Action function (a limb movement, a comment to a spouse which may be "This place is great; let's come back every year" or "Boy; this is the last time we'll ever come here!" or a physical movement away from the hotel) – or, the action may a resultant attitude which later causes an action and so produces an observable effect in the environment. One way or another, there is some impact on the Output (sometimes called output signal or output quantity).

This Output, by definition being one that affects environmental variables (being at the same hotel or a new hotel next year), provides a feedback link to the Input Quantity which is sensed by the Sensor Function. In general, the Input is also subject to effects independent of the system's outputs.

The System (between the two dashed lines) is organized so as to maintain the sensor signal at all times nearly equal to the reference signal, which itself could be constant or changing over time. In order to do this, it produces whatever output is necessary to prevent disturbances from affecting the sensor signal materially. Thus, in the simplest form, the output quantity (response) becomes a function of the disturbance (stimulus). This gives us the Stimulus-Response model with which we are familiar (Fig. 1). Thus, we note that the familiar Stimulus-Response model is simply a special case of a more complex electrical engineering control system!

An important point that strikes us on looking at the model is that it is not so much the input quantity that affects the control system as the sensor function, which is, in common terminology, the perception of the physical variables. Here we clearly the vital point in social psychology or in consumer behavior -- that little or no effect will be had on the system by manipulating the environmental variables unless due attention is paid to the internal functioning of the system itself; unless we know how the system under consideration perceives the environmental inputs (i.e. what the internal representation or the sensor function is).

Another significant point is that, if all we are doing is measuring the sensor (the perception, as most evaluation forms do), we are missing out on the explanatory or predictive power of the error signal – the extent to which the perception fits the reference signal.

Functioning of the model

Let us go on to see what other aspects of behavior this closed-loop model will explain. We know that the system is organized so as to minimize the error signal (i.e. a discrepancy or error reducing system). Therefore, it will tend to make the error signal stay as close to zero as possible. If we regard the Comparator to be a simple difference function, we can represent the functioning of the comparator symbolically as:

Reference Signal - Sensor Signal = Error Signal

Note that each of these signals could be a single attribute one (such as temperature of the hotel room) or a multi-attribute one (such as temperature, cleanliness, décor, bathroom toiletries, price of room, etc.).

If the Error Signal is (in the perfect or almost perfect case) ≈ 0

Then, the Sensor Signal will be ≈ the Reference Signal

Thus, we are assuming that the system tends to strive for zero discrepancy. This implies that the individual wants no dissonance and therefore tends to minimize it. This has, in general, shown to be true (Festinger, 1957). In a particular situation, we can have an individual who can cope with a certain amount of stress (dissonance) and so will not try to force the error signal to zero, but to some internally determined level (E). This does not affect the generalizability of this model. Such a phenomenon can easily be taken into account by putting a non-zero quantity on the right-hand side of the above equation. The results which follow are still true because even in this case the reference signal will turn out to be related to the sensor signal through the new equation:

Reference Signal - Sensor Signal = Minimally acceptable level, E, of the Error Signal

4) Discussion: Implications of the Electrical Engineering Control System Model

Now, what happens if the two are not equal, or if the Error Signal is much greater than the minimally acceptable level? What happens, for example, if a hotel guest has a luxury room which has every possible creature comfort, but a daily swim is very important to the guest, and the pool is a curvy one not suited to lap swimming, or there are a lot of kids splashing around which makes lap swimming almost impossible, or the pool hours are not compatible with the guest's planned schedule of meetings?

The system can work in one of many ways, some of which are listed below:

1) It can change its perception about the environmental variables. Therefore, the Sensor function will change so as to bring the sensor signal in consonance with the reference signal. The subject may say, "Oh well, if I start my laps at this point on the curvy pool and swim to that point, it will be sort of like swimming laps" and/or "I can get in my swim before any of the kids are up, so I can swim laps without disturbing anyone else."
2) Since the sensor signal is, after all, a function of the physical variables (via the feedback loop), it could move to change the physical variables themselves. That is, the system, through the Action function, can produce the appropriate output quantity which acts via the feedback link to change the input quantity. In our example, the customer may check out of that hotel and check in at one that does have a pool conducive to lap swimming, or make a vow never to return to this hotel again. This action is noticed in the phenomena of Motivation for Search and that of brand-switching, to give but two examples from the Marketing literature.
3) The system could affect the input quantity in a way other than by acting directly on it. The customer could affect the input quantity by accepting those inputs which tend to make the sensor signal consonant with the reference signal or avoiding those which tend to make the sensor signal dissonant with the reference signal. For example, the customer may swim laps at a neighboring sports club (with or without the hotel's fiscal or other support);
4) There is one other alternative left to the system in such a situation. It could change the *reference* signal so that it becomes consonant with the sensor signal. Rather than live with the pain of a large error signal throughout the stay in this hotel, the serious swimmer guest may decide that the daily swim is not such a critically important goal after all. The guest may work out at the hotel

gym instead (something that is not easy for a swimmer who travels with swimming attire and swim goggles but not running shoes and clothes suitable for a treadmill!).

So far, we have not discussed the origin of this reference signal. The strong desire to swim every morning is not determined inside the system. It is part of the value system which is self-imposed "from above." It may be analogous to a purpose or goal that governs this operation. With this information that the reference signal is a higher-order goal, we see that to change this is *far more difficult* than to produce an appropriate output, or to avoid or accept an input, or even to modify perceptions about some environmental inputs. Thus, this alternative is least likely to be used by a system under stress (dissonance). To the desk clerk, the guest is simply being unreasonable, but to the guest the daily lap swim is indeed a higher order goal which cannot be easily changed.

Pask (1961) provided an illustration of an "adaptive control system" involving a simple hierarchy of an executive, who Pask refers to as an "overall controller," who has to do his work while being interrupted by several callers. So that he may be able to get his work done, he hires a receptionist, who is called a "sub controller" (incidentally, these gender classifications are in Pask's original example). The successful receptionist will be able to make the selection from among the callers each time period, as to the right person to allow to meet with the executive, and how to deal with those who are rejected – at least for that appointment time period. The executive (overall controller) does not need to know the details of how the receptionist (sub controller) deals with the callers and makes the selection of the person who gets to see the executive. He is only concerned with the result. If he is satisfied with the receptionist's selections, the system is working well. If the receptionist makes the wrong selections from among the callers, the executive will be dissatisfied and may adapt to that environment via a variety of approaches; for example, training her, counseling her, or after a some number of iterations depending upon his managerial approach, firing her). However, the executive *does* have an important selection process of his own: he needs to select the correct receptionist to hire. If he does not select the right person for the job, and the job does not get done, he can try again to hire another receptionist. If that one is not successful and the job still doesn't get done after some number of iterations, he runs the risk of getting fired himself. Thus, there can be any number of levels in a control system. In each level, we have examples (though different ones) of adaptive control. At the top of the hierarchy we have a master controller to whom one or more "sub-controllers" are subordinate. When the output from a sub-controller varies significantly from desirable limits, an alternative sub-controller may be switched in by the master controller. Given that a variety of sub-controllers is available or that the sub-controller can be adjusted, the system as a whole will adapt to the demands of its environment.

Pask's example above is similar to that used in the section on the Reference Signal in our electrical engineering model. It provides support for the concept of a hierarchy of the customer / visitor's goals and recognizes that a higher order goal or reference signal may function as a "master controller" in a control system.

This model has presented a useful way of looking at the theory of behavior and the observation and measurement of it. As yet, however, the discussion could not be complete without explaining the origin of the Reference Signal which we have dealt with above.

To give another example, let us consider the behavior of a consumer in a supermarket, trying to look for a particular brand of a product on the shelves. If it is there, she buys it every time she shops. If it is not, then she searches the shelf where it is usually kept. Next, she looks at nearby shelves. After a while she gives up and goes to another store where she finds and buys that particular brand. An observer would conclude that she is brand-loyal, that the repeated purchase of that particular brand is the consumer's "controlled quality." She will "behave" or cause output (search around, go to another store) in such a way as to keep that quantity under control in spite of the disturbances (not finding the brand at its usual place, the store being out of stock) .

Therefore, she is attempting to keep the error signal (the difference between the reference signal and the sensor signal is having that brand) equal to, or close to, zero. Thus we see that her reference signal says, "Always Buy Brand X." Now we ask where this reference signal comes from. Let us assume, just for convenience, that her reason for brand loyalty is risk reduction. Why does she want to reduce risk?

Because she is afraid of the economic loss involved if it is not at least as good as Brand X. And so on. We could continue asking why, but let us stop arbitrarily at this stage. She wants to reduce risk. Let us not be concerned about the "why" for the moment. Let us accept it as something she regards as another "controlled quantity." Let us rather ask: How will she keep this under control? How will she reduce risk? One answer, very commonly found, is by being brand-loyal to Brand X.

Therefore, we see that the reference signal we talked of earlier, "Always buy Brand X" (in other words, "Be brand-loyal to X") has come from a higher-order control system which regards this as merely the output required to keep its own controlled quantity (risk-reduction) in control. Further, we note that if Brand X is no longer being produced to achieve her goal of risk reduction she would have to buy a different brand until she was convinced that it was what she wanted and therefore her (lower-order) reference signal would change to "Always buy Brand Y." This establishes the hierarchy of the control systems. Clearly, if the output of one is the reference of the other, the former is the higher-order control system. Going down a level is equivalent to asking "how?" and going up a level is equivalent to asking "why?" We could keep going up, looking for higher-order goals until we might reach the goal of self-actualization, but in a given situation we would not need to go higher than one level if we are studying a particular example of behavior.

We would only have to realize that the reference signal comes from a higher-order control system. This discussion has enabled us to find in our model a place for the concept of "goals or purposes and hierarchies among goals." This leads us to another implication concerning the study of behavior. Earlier, we noted that one way a system could adjust to a discrepancy between the reference signal and the sensor signal would be to modify the reference signal itself. This would involve more effort than dealing with the discrepancy in another alternative way of those mentioned earlier, because they all deal with the lower-order control system and not the higher-order one. Pinquart, Silbereisen, and Wiesner (2004) found in discrepancy-reducing processes, that "increases in goal attainment were associated with increased self-esteem whereas reductions of aspirations were not systematically associated with self-esteem change" and further that younger people and adolescents were more likely to use pursue their goals tenaciously rather than adjust them. While this may be part of a maturing process, it may not be so; as a caveat, we note that the adolescents of 2004 are the customers of today.

Therefore, in order to influence a person or group of persons, the provider of the service in the hospitality and tourism industry must make efforts to ensure: (1) that the reward is something that the customer really wants or needs, given his or her existing reference signal or goal, and (2) that the best way the customer can attain the reward is by doing what the provider wants the guest to do (i.e. come to my hotel rather than the other alternatives). This may sound like a tall order, but failure to satisfy these criteria may well lead to a lost customer.

Before we complete the discussion of the Reference Signal and its implications for consumer choice in the Hospitality and Tourism industry, we must note that the model is not intended to be a static one. The reference signal is not always a constant entity. It may change over time, and this is an additional reason to collect information (at least once every 4-5 years) on the Reference Signal along with the Sensor Signal. Collecting data on a person's perceptions of the hotel room or the cruise, gets at the Sensor Signal but not the Reference Signal. Thus, with the current survey and feedback instruments we have, we cannot compute the Error Signal, which is the driver of behavior.

Following this line of reasoning, it would be appropriate to consider feedback and survey mechanisms and instruments that attempt to capture customers' *expectations* in addition their performance ratings. For example, on the typical feedback form, the guest may be asked to rate the following dimensions:

Cleanliness of:

1. Bathroom
2. Hallway
3. Lobby
4. Drapes
5. Carpet

6. Linens
7. Room (overall)
8. Grounds
9. Workout room
10. Pool

Maintenance:

1. Heating / Air-conditioning (Room Temperature)
2. Toilets
3. Telephone
4. Water pressure
5. Water temperature
6. TV
7. Remote
8. Game console
9. Wake-up call

Restaurant:

1. Restaurant décor
2. Banquets or Catering
3. Service in restaurant
4. Wine selection
5. Alcohol selection
6. Room Service
7. Menu prices

One of the conclusions of the Electrical Engineering Control System Model is the perceptions or ratings on each of these dimensions (Sensor Signal), while interesting, are not at all sufficient to understand customer behavior. A major finding of this approach is the realization – and conceptual basis – that *low scores on any of these 26 dimensions are not created equal* in terms of their impact on future behavior! We cannot know the salience of each of these dimensions unless we ask about the guest's Reference Signal.

For example, for a guest who uses only room service and who is a teetotaler, high or low scores on the vast majority of restaurant dimensions such as restaurant décor, banquets or catering, service in restaurant, wine selection, and alcohol selection are meaningless in understanding whether he or she enjoyed the stay and whether he or she would return. The same applies to the serious swimmer mentioned earlier for the workout room – pool hours would be more of a driver of behavior. And a game console has no significance for some guests, and even some of the cleanliness dimensions may be far more relevant than some others. Until we know the guest's Reference Signal, the (Sensor Signal) ratings on a form are not of much use.

How can we reasonably implement the findings of this model? By collecting guests' Reference Signal data from guests on each of these dimensions. Fortunately, while it is particularly important for those who are repeat customers (the heavy user segment), it is also easier to do so from their "loyalty" number contact information. At the very least, we can collect Reference Signal data once every 4-5 years from loyal guests on each of these dimensions because we have access to their e-mail addresses. Then, because Reference Signal data do not change frequently (since it is a higher order concept related to a person's value systems), all that we would need to do after each visit is monitor the performance rating (Sensor Signal) data. Then, we can compute an Error Signal for each dimension based on the last visit's Sensor Signal data compared with the existing Reference Signal data. So, the data collection process is not significantly more onerous than currently exists (only one more questionnaire every 4-5 years), and indeed, frequent customers may actually feel pleased to be asked for their Reference Signal dimensions and scores because they would know that what is important to them is important to the facility owner.

Used in ways mentioned above in the Implications and Discussion section, the electrical engineering control system approach may make invaluable contributions to understanding consumer choice in the hospitality and tourism industry.

5) Limitations and directions for future research

This paper has all the limitations of being a conceptual paper, without empirical evidence to support a set of hypotheses. Its contribution is in the incorporation of electrical engineering control systems concepts in understanding of human behavior. Directions for future research would clearly include the development of testable hypotheses and tests of these hypotheses based on data.

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