ASEAN Entrepreneurship Journal (AEJ)

# Sustainability of Food Vending Machines in Singapore

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***Abstract***

*The business costs in Singapore can be high. The rentals are high as land is scarce. There is also a labour crunch and F&B operators face a challenge hiring staff. F&B traditionally is labour intensive and prime locations a major driver for walk-in sales. Rental costs for prime locations could be at a high premium cost. On the other hand, many Singaporeans do not cook at home and tend to have their meals ouside. Food Vending Machines provide an interesting alternative for entrepreneurs. The assumption requiring validation is the acceptance of customers to use these vending machines. If customers accept these vending machines, then it can be sustainable.*
*The objective of this research is to determine the sustainability of food vending machines in Singapore. Particularly, this research describes the results of a technology acceptance model and critical incident study based on a simple random sample of 131 usable incidents involving food vending machines through online and face-to-face surveys. The results of this study suggest that while some factors affecting the acceptance of food vending machines are aligned with the technology acceptance model, such factors appear to be of less significance. The taste and quality of food are more significant contributors towards consumers' satisfactory/dissatisfactory experiences.*

***Keywords: Singapore; Food Vending Machines; Technology Acceptance Model; Critical Incident Technique***

***ARTICLE INFORMATION***

Received: 29 Jan 2023
Revised: 10 Feb 2023
Accepted: 18 Mar 2023
Published: 30 Apr 2023

## 1.0 INTRODUCTION

Self-service technology (SST) refers to any facility that enables consumers to 'produce services for themselves without assistance from firm employees' (Beatson, Lee & Coote, 2007). Food vending machines are a series of vending machines that dispense hot meals and beverages throughout the day and is targeted at "making Singapore's food and beverage sector more manpower lean" (Tay, 2016).

The objective of this research is to determine the sustainability of food vending machines in Singapore. Sustainability here is attributed to Singaporeans' acceptance and satisfaction of food vending machines. This is of particular interest to Singapore for a number of reasons. Firstly, the socio-economic landscape in Singapore is that many couples are both working and they would consume outside food rather than cook meals, especially for mid to lower income level. They would typically purchase their food from hawker centers and coffee shops. The preservation of hawker centres and affordability of food has become a political objective.

Secondly, there is a labour crunch in Singapore. It is difficult to get staff for F&B. Thirdly, land is scarce in Singapore and rental costs are high. Wang & Talib (2019) discussed some of the issues facing small companies in Singapore and labour crunch was a main issue.

F&B industry has traditionally been labour intensive. However, we have witnessed a transformation in recent years to more automation, digitalisation and technology, This has been beneficial from the operator's viewpoint, in terms of cost, efficiency and reduction of human errors. F&B operators of course are always concerned about level of customer acceptance.

Operating Food Vending machines would, in a sense, be the ultimate utopia. Staff costs and rental costs would substantially reduce. Operators would only need a central kitchen and no need for sitting area.

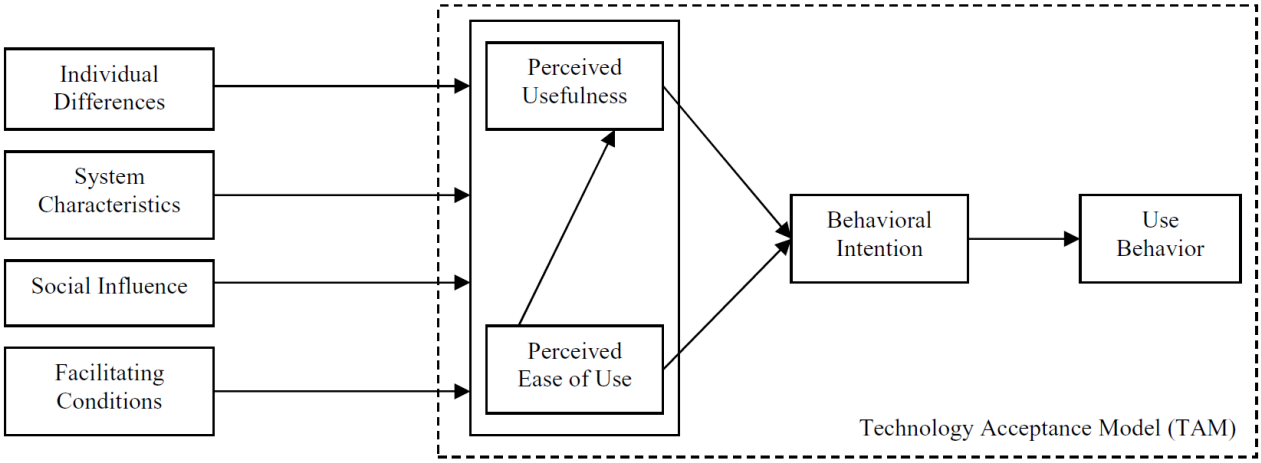


Figure 1: Technology Acceptance Model. Viswanath and Hillol,2008.

## 2.0 LITERATURE REVIEW

SSTs are technologies that provide services independent of direct employee assistance. SSTs are available in Singapore, with self-ordering kiosks at fast-food chains (Lin, 2016) and food vending machines serving cooked meals (Tay, 2016).

Self-service is an innovation that has engaged discussions about future opportunities (Galinyte & Savareikiene, 2012, p. 19). Indeed, McKinsey & Company (2016), reported that 73% of a food worker's job scope can be automated due to their repetitiveness, and food service and retailing are most susceptible to automation. Mueller & Tailon (2016) associate the raise in SSTs with saving time and the pressure to minimize cost. It can also reduce dependency on human labour. F&B have traditionally been labour intensive. However, we have witnessed the transformation of the F&B industry to have more automation and use of technology, for example self-ordering and the use of robots. This transformation has been beneficial from the F&B operators' viewpoint; in terms of cost reduction, efficiency, and reduction of human errors. Food Vending Machines would be ideal for F&B operators. The only concern would be the level of customer acceptance.

It is apparent that SSTs would be a dominant component of future global services. To further our understanding, we examined SSTs from the viewpoint of customers in the F&B industry.

The Technology Acceptance Model (TAM) is extensively employed for adopting and using IT (Viswanath & Hillol, 2008, p. 274). The TAM is reliable and valid which helps to understand user acceptance towards information technologies (Akgun, 2017; Bulul & Cuhadar, 2012).

As shown in *Figure 1*, the TAM model consists of four factors that affect the "perceived usefulness and ease of use — social influence, individual differences, facilitating conditions and system characteristics" (Viswanath & Hillol, 2008, p. 276). Conjunctively, there are three psychological factors that facilitate the acceptance of technology. They are self-efficacy, social pressure, and technology anxiety (Meuter et al., 2005; Schliewe & Pezoldt, 2010). According to Chia & Talib (2017), "social influence in the TAM is associated with social pressure, while individual differences are associated with self-efficacy and technology anxiety" (p. 79).

Self-efficacy is the subjective judgement of an individual who possesses sufficient skill to operate technologies. Individuals who are resistant to SSTs might believe they lacked such skills, rather than actually lacking the skills required to operate these SSTs (Liu et al., 2012, p. 1824-1825).

Social pressure is the change in subjective feelings, motives, and behaviours that materialize in individuals due to actual or imagined presence of others (Kinard et al., 2009, p. 305). According to Dahl et al. (2001), in a complex setting where purchase process involves less routine, social pressure becomes more prominent and negatively affects the emotions and attitudes of individuals during purchase. Hence, individuals

experience higher embarrassment level during a less routine purchase when an actual or imagined social presence is present.

Technology anxiety refers to the anxious feeling of individuals when using new technology (Gelbirch & Sattler, 2014). Technology anxiety negatively affects the use of SSTs by decreasing perceived ease of use and successive desire to use (Venkatesh & Bala, 2008; Phang et al., 2006; Venkatesh, 2000). Particularly, for consumers with an initial satisfying experience, technology anxiety influences satisfaction levels and future behaviours consisting of the willingness to participate in positive word-of-mouth and intention of subsequent usage (Meuter et al., 2003).

Prior research has examined the effects of the psychological constructs on the usage decision of self-checkout kiosks in Singapore (Chua & Talib, 2017). The findings show that societal and demographic factors inclusive of individualism and age respectively affect the levels of self-efficacy, social pressure, and technology anxiety (Chua & Talib, 2017). This research will examine the effects of self-efficacy, social pressure, and technology anxiety in the context of food vending machines in Singapore to determine whether they are aligned with TAM.

According to Papouli (2016), the Critical Incident Technique (CIT) is a verbal or written recount of an event that is of significance to the speaker or writer that triggered thorough critical analysis. The critical incidents can be "unique or common, current or past, pleasant or unpleasant". Most importantly, they cannot be "planned, anticipated, and controlled" (p. 59). Meuter et al. (2000), described the technique as the categorization of critical incidents with the aim of discovering emergent patterns. The key lies in describing specific events in detail rather than identifying the cause of their satisfaction or dissatisfaction.

Former research has used CIT to explore the sources of customer satisfaction and dissatisfaction when customers interact with technological interfaces. Meuter et al. (2000) found that (1) SSTs "saved time" by performing more quickly, (2) customers are not restricted by limited service hours, (3) "technology failure" of a breakdown when customers are interacting with the technology leads to dissatisfaction, and (4) failure leading to dissatisfaction is caused by customers' own action (p. 56). Meuter et al. (2000) explored SSTs among the U.S. population. We investigated factors pertaining to food vending machines among the Singapore population. This enabled us to examine whether the sources of satisfaction and dissatisfaction are important in the Singapore context.

Bradley (1978), describes self-serving bias as the "tendency of taking credit for positive outcomes and deny responsibility for outcomes that are negative" (p. 56). Former research has analysed this bias in the context of 2008 financial crisis. Self-serving bias was used more extensively in crisis situations as compared to non-crisis situations as managers tend to present the best versions of themselves and place responsibility for negative outcomes on environmental factors (Keusch et al., 2012). This research will test whether customers' satisfying/dissatisfying experience is associated with themselves, or food vending machines.

## 3.0 METHODOLOGY

### 3.1 Research Design

The survey instrument and constructs were adopted from Chua & Talib (2017). Two similar sets of questions were used to compare whether the factors affecting the acceptance of food vending machines are aligned with TAM. In Chua & Talib (2017), "self-efficacy was obtained via an adapted scale from Pedersen (2005) and Compeau and Higgins (1995), where respondents conveyed their level of confidence in performing a particular behaviour. To measure social pressure, respondents in Bhattacherjee (2000) were tasked to rate how easily they are persuaded by those of importance. Technology anxiety was determined via an adapted scale from Igbaria and Parasuraman (1989), where respondents were instructed to indicate their anxiety level when using technology" (p. 85). The constructs consisting of self-efficacy, social pressure, and technology anxiety contain questions in the form of a "5-point Likert scale" with "strongly disagree and strongly agree" at opposing ends of the spectrum (Chua & Talib, 2017, p. 85).

Additional survey questions were adopted from Meuter et al. (2000), to investigate the satisfying and dissatisfying customer experiences with food vending machines. In Meuter et al. (2000), the CIT was utilised; respondents were asked to describe "specific incidents in detail, rather than identifying the cause of their satisfaction/dissatisfaction" (p. 53). The incidents were

then categorised into sources of satisfaction/dissatisfaction.

As opposed to the research conducted by Meuter et al. (2000) that pertains to SSTs, our survey focused on food vending machines. Therefore, our survey ranked the sources of satisfaction/dissatisfaction in Meuter et al. (2000), and brought it to the context of food vending machines.

In relation to Meuter et al. (2000), the relationship between satisfied/dissatisfied customers and the measure of attributions, actions taken, and future behaviours towards food vending machines were explored. In Meuter et al. (2000), respondents "were tasked to indicate who they attribute the outcome of the satisfying/dissatisfying experience to" (p. 54). Next, respondents were asked whether actions taken, in the form of feedback concerning the satisfying/dissatisfying experience, were made. Behaviour intentions relating to word of mouth and repeat purchases were also assessed.

Apart from Chua & Talib (2017) and Meuter et al. (2000), the survey was supplemented with questions to identify the main reason for not providing feedback. With these questions functioning as a focal point, recommendations can be made to enhance the sustainability of food vending machines.

Finally, the relationship between demographic variables (age, highest education qualification attained, employment status, and household monthly income), psychological factors (social pressure, self-efficacy, and technology anxiety), and subsequently the type of experiences (satisfying, dissatisfying) were explored.

A pilot study was conducted on three respondents of differing age group and alternations were made to the questions for clarity. An online survey was conducted in Singapore only.

### 3.2 Analysis

Two sample t-tests were performed to investigate whether the means of the factors affecting the acceptance of food vending machines and technology are significantly different statistically. Two sets of multiple regression were conducted. This explored the relationship between demographic variables (age, highest education qualification attained, employment status, household monthly income) and psychological factors (social pressure, self-efficacy, and technology anxiety). The comparison is then bridged by the latter which explored the relationship between psychological factors and the type of experiences (satisfying, dissatisfying).

Chi-squared tests were conducted to explore the relationship between the type of experience (satisfying, dissatisfying) and the nature of attribution outcome and actions taken. Comparison between the likelihood of future behaviour and customers with satisfying/dissatisfying experiences was made via a one-way ANOVA test. Finally, contingency and correlation analysis were utilized to identify the relationship between demographic variables, psychological factors, and future behaviour.

### 3.3 Sample Characteristics

137 respondents attempted the survey questionnaire. Six responses were eliminated because they were either attempted partially or there were no variation in the choices selected. This resulted in a final sample of 131 respondents – 82 (62.60%) were users of food vending machines while 49 (37.40%) were non-users. Of which, 70.73% and 29.27% of the users had a satisfactory and dissatisfactory encounter respectively.

## 4.0 RESULTS

### 4.1 Technology Acceptance Model

Two sample t-tests were performed to investigate whether the difference in means, of the factors affecting the acceptance of food vending machines and technology, is statistically significantly different. Specifically, P-Value$_1$ consists of the p-values of social pressure, self-efficacy, and technology anxiety. Two-tailed tests are conducted with 0.05 significance level. Should the p-value be lesser than the level of significance, the null hypothesis: There is no significant difference between users of food vending machines and technology, will be rejected. Technology anxiety ($\rho$ = .0002) garnered the strongest significant mean value difference, followed by social pressure ($\rho$ = .0019). On the contrary, the p-value of self-efficacy ($\rho$ = .5826) exceeds the level of significance. Hence, the acceptance of food vending machines and TAM are aligned in self-efficacy. Users of

food vending machines and technology differ in social pressure and technology anxiety.

Additionally, the variance of social pressure, self-efficacy, and technology anxiety were compared to acquire general dispersions between users of food vending machines ($Variance_1$) and technology ($Variance_2$). The self-efficacy of users of food vending machines is the most varied ($s^2$ = .4004) while the social pressure for users of technology is the least varied ($s^2$ = .0150).

### *4.1.1 Technology anxiety.*

Although users of food vending machines and technology have low technology anxiety ($\bar{x}_1$ and $\bar{x}_2 \leq 2.86$), users of food vending machines ($\bar{x}_1$ = 1.87) have a lower level of overall technology anxiety than users of technology ($\bar{x}_2$ = 2.40). Particularly, the greatest difference is evident when users were asked the degree to which they fear they might damage new technology in same way, where users of food vending machines ($\bar{x}_1$ = 1.85) have a much lower level of technology anxiety than users of technology ($\bar{x}_2$ = 2.55). The lowest difference is apparent when users were asked whether they are unable to keep up with important new technology advances, where users of food vending machines and technology garnered a close mean of $\bar{x}_1$ = 1.94 and $\bar{x}_2$ = 2.24 respectively.

### *4.1.2 Social pressure.*

Users of food vending machines have a lower level of social pressure ($\bar{x}_1$ = 2.83) than users of technology ($\bar{x}_2$ = 3.43) who have a fairly neutral level of social pressure. Specifically, the greatest difference pertains to whether users felt they are expected to be using new technology ($\bar{x}_1$ = 2.76, $\bar{x}_2$ = 3.53). As displayed in *Table 2*, at least a third of the users of food vending machines (34.15 %) and technology (30.61%) felt neutral that they were expected to be using new technology. Concurrently, majority of users of food vending machines either disagreed (30.49%) or strongly disagreed (12.20%) with the statement, while majority of users of technology either agreed (40.82%) or strongly agreed (14.29%) with the statement.

### *4.1.3 Self-efficacy.*

Users of food vending machines and technology have relatively similar self-efficacy. Particularly, users of food vending machine ($\bar{x}_1$= 3.93) having a slightly higher overall mean than users of technology ($\bar{x}_2$ = 3.77). The greatest difference pertains to whether users are able to use new technology if they could ask someone for help. Users of food vending machines ($\bar{x}_1$ = 2.71) generally disagree with the statement while users of technology hold a neutral view ($\bar{x}_2$ = 3.59). Interestingly, both users of food vending machines and technology showed an increase in confidence in using new technology if they had seen someone use them before ($\bar{x}_1$ = 3.79 , $\bar{x}_2$ = 3.96), as opposed to asking someone for help ($\bar{x}_1$ = 2.71 , $\bar{x}_2$ = 3.59) .

## 4.2 Multiple Regression 1

Multiple regression has been conducted to explore the relationship between the dependent variables (social pressure, self-efficacy, technology anxiety) and independent variables (age, highest education qualification attained, employment status, and household monthly income). The dependent variables are represented by dummy variables. For instance, the value of a dummy variable is "0" if social pressure is present, and "1" if social pressure is not present. The same concept is used for self-efficacy and technology anxiety. The independent variables are categorized into sub-groups.

### *4.2.1 Social Pressure.*

The Wald test is conducted to obtain Wald Chi-Square values to find out if the independent variables are significant enough to affect social pressure. The results are displayed in *Table 3.* Household monthly income is the only significant variable (Wald Chi-Square = 4.4335) while age, highest education qualification attained, and employment status are not significant with a Wald Chi-Square of close to zero (.4330, .6921, .0560 respectively).

Similarly, odds ratio tests are conducted to obtain odds ratios to measure the association between the independent variables (age, highest education qualification attained, employment status, and household monthly income) and dependent variable (social pressure). Household monthly income is the most noticeable variable. The 3.3884 odds ratio implies that respondents of higher income is thrice as likely to develop social pressure as compared to those with lower income. It is important to take into consideration that the confidence interval of this variable is also high (Lower

95% = 1.0881, Upper 95% = 10.5518). From the odds ratios, the characteristics of respondents with social pressure include those who: (i) are above the age of 30 (Odds Ratio = 2.2701), (ii) receive higher education (Odds Ratio = 1.6425), (iii) are currently studying (Odds Ratio = 1.1402), and (iv) receive higher household monthly income (Odds Ratio = 3.3884).

#### *4.2.2 Technology Anxiety.*

The Wald test is conducted to obtain Wald Chi-Square values to find out if the independent variables are significant enough to affect technology anxiety. As displayed in *Table 4* the Wald test is significant for age and employment status, with Wald Chi-Square of 2.1420 and 1.9685 respectively. Education qualification attained and household monthly income were not significant, with a value close to zero (Wald Chi-Square = .2719 and .2657 respectively).

Hence, we explore the odds ratios for age and employment status. Odds ratio tests are conducted to obtain odds ratios to measure the association between the independent variables (age and employment status) and dependent variable (technology anxiety). The odds ratio of 5.5878 implies that respondents above the age of 30 are at least five times more likely to develop technology anxiety as compared to those aged 30 and below. The confidence interval of employment status is very broad (Lower 95% = 0.5579, Upper 95% = 55.9676). The odds ratio of employment status is slightly lower than age. For employment status, students are three times more likely to develop technology anxiety as compared to those who are currently not pursuing their studies (Odds Ratio = 3.1447). The confidence interval for employment status is also broad (Lower 95% = 0.6346, Upper 95% = 15.5843). The characteristics of respondents with technology anxiety include those who: (i) are above the age of 30 (Odds Ratio = 5.5878), (ii) receive higher education (Odds Ratio = 1.4555), (iii) are currently studying (Odds Ratio = 3.1447), and (iv)receive lower household monthly income (Odds Ratio = 1.3823).

Comparing the odds ratio across dependent variables, respondents with social pressure are more likely to develop technology anxiety. This statement is true concerning three independent variables (age, highest education qualification attained, employment status) except household monthly income. Particularly, while social pressure is present in respondents with high household monthly income (Odds Ratio 3.3884), they are less likely to develop technology anxiety (Odds Ratio = .7234).

#### *4.2.3 Self-Efficacy.*

The Wald test is conducted to obtain Wald Chi-Square values to find out if the independent variables are significant enough to affect self-efficacy. The following results of self-efficacy are displayed in *Table 5*. Based on the Wald test, all the independent variables are not significant enough to affect self-efficacy (age = 8.2262e-5, highest education attained = 0.0000, employment status = 6.6472e-5, monthly income = .5199). The main reason for the insignificance is due to the presence of self-efficacy in almost all respondents (95.12%).

### 4.3 Multiple Regression 2

Another multiple regression has been conducted to explore the relationship between dependent variables (satisfying and dissatisfying experience) and independent variables (**social pressure** and **technology anxiety**). Self-efficacy has been omitted, as explained previously, due to the insignificance of the Wald test. The dependent variables are represented by dummy variables. Particularly, satisfying experiences are given the dummy variable of "0", and "1" for dissatisfying experiences.

The Wald test is conducted to obtain Wald Chi-Square values to find out if the independent variables are significant enough to affect the dependent variables. Based on the Wald test conducted, as displayed in *Table 6,* **social pressure** is the only significant variable (Wald Chi-Square = 16.2266) while technology anxiety is not significant (Wald Chi-Square = .0004).

Odds ratio tests are conducted to obtain odds ratios to measure the association between the independent variables and dependent variables. **Social pressure** is the most noticeable independent variable from the odds ratio. The 9.3097 odds ratio implies that respondents with social pressure are nine times more likely to have a satisfying experience from using food vending machines. The 1.0140 odds ratio for **technology anxiety** implies that respondents without technology anxiety are slightly more likely to have a satisfying experience from their purchases.

Overall, respondents belonging to the higher income group, with household monthly income greater than SG$ 5,000, are three times more likely to develop social pressure and are nine times more likely to have a satisfying food vending machine experience.

## 4.4 Sources of Satisfaction and Dissatisfaction

The sources of satisfaction and dissatisfaction of food vending machines are investigated. The percentage of each sources of satisfaction and dissatisfaction are tabulated in *Table 7*, and notable sources of satisfaction and dissatisfaction will be discussed.

### *4.4.1 Better than alternatives.*

For 93.98% of the satisfying experience, respondents perceived food vending machines to be better than interpersonal methods of food purchase. This group is divided into the eight sub sources, as displayed in *Table 7*, and three sub sources will be discussed.

### *4.4.2 Food was good.*

This is the largest category comprising of 50.60% of the satisfying responses. A comparison was made against microwavable food sold in convince stores where a respondent commented that food dispensed from vending machines "tasted much better than expectations". While some respondents were "pleasantly surprised that the taste was not compromised", a respondent detailed his encounter and that "the aroma slithered pass [his] sense, and [he] gobbled the food down". Additionally, the food dispensed were "piping hot" and "fresh". Other comments illustrating the food include the portion served where respondents described the "quantity of food was decent".

### *4.4.3 Good customer service.*

Although the vending machines are automated, service crew might be present to guide customers, especially as the vending machines are at its initial stage of launch. Comprising of 3.61% of the satisfying responses, respondents recounted exceptional customer service provided. A respondent gave a detailed recount of his experience; "The service crew was very friendly and she taught me step by step how to use the vending machine".

### *4.4.4 New experience.*

In 3.61% of the satisfying incidents, the vending machines provided a new experience for customers. Respondents were fascinated and "Amazed by the machine for the first time". Others commented that the "Whole experience was interesting".

### *4.4.5 Solved intensified need.*

3.61% of users' satisfying experience involved the food vending machine solving an intensified need. Most food vending machines in Singapore operate around the clock. Satisfaction was driven by the vending machines' ability to satisfy respondents' hunger when food options were lacking. For instance, a respondent commented, "The food canteen was not opened in school and I was very hungry. Luckily, there was a vending machine to order delicious hot food had helped me satisfy my hunger".

### *4.4.6 Did its job.*

For 2.41% of satisfying respondents, having the vending machine complete what it is supposed to do was sufficient to satisfy them. A respondent claimed that the purchase process "Went normally, I got my food".

### *4.4.7 Technology failure.*

19.35% of dissatisfied respondents were disappointed with incomplete or wrong transactions. For instance, a customer recounted that his coin was stuck in the vending machine and he ended up not getting his food. Another customer accused the vending machine of dispensing the wrong product and provided the example of "I choose A, gave me B".

#### *4.4.8 Technology design problem.*

This category consisted of 9.68% of dissatisfied respondents who were dissatisfied with their experience despite the vending machine performing what it was intended to do. For instance a respondent, who had gotten his food from the vending machine, was dissatisfied that his $6 change was dispensed in 10-cent and 20-cent coins. Another respondent complained that his order "Took a long time to heat up".

#### *4.4.9 Customer driven failure.*

3.23% of dissatisfied respondents admitted that their dissatisfaction was caused by their own actions. A respondent commented that he "Did not have cash on [him] and could not use the [vending] machine. [He] ended up having to go to the nearest ATM which is a distance away and went to a coffee shop instead.

#### *4.4.10 Food driven failure.*

Of those with a dissatisfying experience, 61.29% were dissatisfied with the food dispensed. Particularly, many felt that the taste was not up to expectation. For instance, respondents described the food was "Bland and [a] lumpy mess" while others indicated that "The sandwich was horrible and the sauce soaked the whole wrapper. The bread was soggy because of that". A few of the respondents expressed their disappointment because the "Part of [the food] is hard and part of it is cold". Additionally, few respondents argued that their food were "Not fresh" and their food portion were "not filling".

### 4.5 Attributions, Actions Taken, Future Behaviour

#### *4.5.1 Attributions.*

A chi-square test was conducted to obtain the value of chi-square and the associated probability to test the relationship between the type of experience and nature of attribution outcome. A weak relationship existed between the type of experience (satisfying versus dissatisfying) and the nature of attribution outcome (vending machine, respondent, to both, or to neither) where $\chi^2 = 3.341$, $\rho \leq .3419$.

#### *4.5.2 Actions taken.*

A chi-squared test was conducted to obtain the value of chi-square and the associated probability to test the relationship between the type of experience and feedback behaviour. The type of experience (satisfying versus dissatisfying) and feedback behaviour (yes versus no) are independent ($\chi^2 = .147$, $\rho > .70$).

We explored the relatively high rate of respondents who did not provide feedback. The relationship between types of experiences and reasons for not providing feedback was examined using a chi-squared test where the chi-square and associated probability were obtained. Among those who did not provide feedback, there is a strong relationship between the type of experiences (satisfying versus dissatisfying) and reason for not providing feedback (tedious process, time consuming, unaware of feedback channels, not having any comment to provide, others) where $\chi^2 = 9.341$, $\rho \leq .0534$.

#### *4.5.3 Future Behaviours.*

A one-way ANOVA test was conducted to obtain the F ratio and associating probability to find out whether there existed a statistically significant difference, of the likelihood of future behaviour, between customers with satisfying experience and customers with dissatisfying experience. There was a statistically significant difference in the likelihood of future behaviour, between customers with satisfying experience and customers with dissatisfying experience as determined by one-way ANOVA ($F = 31.0915$, $\rho < .0001$). In particular respondents with satisfying experience ($\bar{x}_3 = 5.15517$) are more likely to engage in future behaviours, consisting of recommendations and repurchase, than their dissatisfying counterparts ($\bar{x}_3 = 3.27083$). Additionally, the mean of satisfying experience is slightly more dispersed ($s = 1.40552$) than that of dissatisfying experience ($s = 1.35918$) towards the likelihood of future behaviours. Customers with dissatisfying experiences are more likely to repurchase ($\bar{x}_3 = 3.50000$) than make recommendation ($\bar{x}_3 = 3.04167$). On the contrary, customers who are satisfied are almost as equally likely to repurchase ($\bar{x}_3 = 5.17241$) and make recommendations ($\bar{x}_3 = 5.13793$). However, the likelihood of satisfied customers making a repurchase ($s = 1.36546$) is less varied than the likelihood of satisfied customers making recommendations ($s = 1.53838$).

A correlation analysis was conducted to obtain the correlation between the factors of technology acceptance model and future behaviour. This is to find out whether the presence of future behaviours of making repurchases and recommendations are affected by social pressure, self-efficacy, and technology anxiety. The correlation analysis revealed the strongest positive relationship between social pressure and future behaviour ($r$ = .6865), while the weakest negative relationship lies between technology anxiety and future behaviour ($r$ = -.1173). A relatively weak relationship exist between self-efficacy and future behaviour ($r$ = .1962). Using a significant level, $\alpha$ of .05, the correlation between social pressure and future behaviour is statistically significant ($\rho \leq .05$), while the correlation between technology anxiety/self-efficacy and future behaviour is not significantly significant ($\rho \geq .05$). Customers engaged in future behaviour, consisting of repurchase and recommendation, reported higher levels of social pressure.

## 5.0 CONCLUSION AND RECOMMENDATIONS

This research has identified various factors that influence the acceptance of food vending machines and its alignment with the TAM. Additionally, the sources, attributions, actions taken, and future behaviour leading and resulting from customer satisfaction and dissatisfaction have been explored. These insights are useful for existing and potential vendors who are planning to introduce new food vending machines in Singapore.

Suria Sulaiman et al (2021) researched the food trucks business in the food and beverage industry in Penang, Malaysia. They investigated the consumers' preference towards the food truck business by focusing on three factors: variation of food, price, and the trends of the food truck business and found significant relationship.

Given the vast design of food vending machines, explicit comparisons were not made between food vending machines operating via an electronic touch screen user interface, and those operating on physical buttons. The epitome of user interfaces lies in enhancing one's purchase experience. Another avenue, concerning the differing user interfaces, can be made for further research. Specifically, the difference between the sustainability of food vending machines operating in an electronic touch screen user interface vis-à-vis those operating via physical buttons can be explored. Additionally, further research could be designed to investigate whether having a touchscreen user interface results in a more compelling and hence satisfying purchase experience for food vending machine users.

The TAM encompasses an array of factors that could potentially affect ones' acceptance of technologies. This research, however, focuses on the role psychological factors namely social pressure, technology anxiety, and self-efficacy play in the usage of food vending machines. Further research could emphasize prominent factors that motivate customers to opt for food vending machines. Additionally, as service crew may not be present to provide guidance as the pilot initiative escalates into its later stages, it is important to examine the role customers play in the food vending machine purchase process for a more holistic purchase experience.

This research provides the first step towards a more informed understanding towards food vending machines and its sustainability. When food vending machines are better comprehended, effective measures can then be introduced. Ultimately, food vending machines could be escalated from its initial novelty to an essential commodity that negates Singapore's manpower reliance, and high rental costs.

**Author Contributions:**
Conceptualization: Lim Wan Qin and Ameen Talib; Methodology: Lim Wan Qin and Ameen Talib; Data collection and analysis: Lim Wan Qin; Supervision and Review of data analysis: Ameen Talib; Writing original draft: Lim Wan Qin; Editing and final writing: Ameen Talib; Supervision: Ameen Talib; Project administration: Ameen Talib. All Authors have read and agreed to the published version of manuscript.

**Funding:** This research has received no external funding

**Acknowledgments:** This research is part of a final year thesis at Singapore University of Social Science (SUSS). We acknowledge the additional motivation provided by this research being a requirement for graduation.

**Conflict of Interest:** The authors declare no conflict of interest.

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| TABLE 1: TECHNOLOGY ACCEPTANCE MODEL | | | | | |
|---|---|---|---|---|---|
| **Item** | **Mean[1] (Food vending machines)** | **Mean[2] (Technology)** | **P-Value1 Mean (Food vending machines) VS Mean (Technology)** | **Varriance[1] (Food vending machines)** | **Variance[2] (Technology)** |
| My immediate family would think I should use new technology | 2.65 | 3.41 | | | |
| It is expected that I should be using new technology | 2.76 | 3.53 | | | |
| People I look up to would expect me to use new technology | 2.67 | 3.22 | | | |
| My immediate family would approve of using new technology | 3.20 | 3.49 | | | |
| My immediate family would agree that using new technology is a good thing | 2.88 | 3.49 | | | |
| **Social Pressure Overall** | **2.83** | **3.43** | **.0019** | **.0500** | **.0150** |
| I could use new technology without the help of others | 4.34 | 3.84 | | | |
| I could use new technology even if I had never used hem before | 4.10 | 3.65 | | | |
| I could use new technology if I could ask someone for help | 2.71 | 3.59 | | | |
| I could use new technology even if no one showed me bow to do it first | 4.33 | 3.65 | | | |
| I could use new technology on my own | 4.29 | 3.94 | | | |
| I could use new technology if I had seen someone else use them before | 3.79 | 3.96 | | | |
| **Self-Efficacy Overall** | **3.93** | **3.77** | **.5826** | **.4004** | **.0256** |

TABLE 2: IT IS EXPECTED THAT I SHOULD BE USING NEW TECHNOLOGY

| Score | Users of food vending machines | Users of technology |
|---|---|---|
| | Percentage | Percentage |
| 1 (Strongly Disagree) | 12.20 % | 2.04% |
| 2 (Disagree) | 30.49 % | 12.24% |
| 3 (Neutral) | 34.15 % | 30.61 % |
| 4 (Agree) | 15.85 % | 40.82 % |
| 5 (Strongly Agree) | 7.32 % | 14.29 % |

TABLE 3: SOCIAL PRESSURE

| **Effect Wald Tests** | | | | | |
|---|---|---|---|---|---|
| **Source** | | **Npram** | **DF** | **Wald Chi Square** | **Prob>ChiSq** |
| Age | | 1 | 1 | 0.43299058 | 0.5105 |
| Highest Education Qualification Attained (Higher Education = Diploma, Degree & Postgraduate. Lower Education = Others) | | 1 | 1 | 0.69205559 | 0.4055 |
| Employment Status | | 1 | 1 | 0.05601747 | 0.8129 |
| Household Monthly Income (Higher Income = Above $5,000. Lower Income = $5,000 and below) | | 1 | 1 | 4.43353661 | 0.0352 |
| **Odds Ratios** For Social Pressure (0=Yes. 1=No) odds of 0 versus 1 | | | | | |
| **Odds Ratios for Age (Above 30. 30 and Below)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Above 30 | 30 and Below | 2.2701403 | 0.5105 | 0.1974796 | 26.096553 |
| 30 and Below | Above 30 | 0.4405014 | 0.5105 | 0.0383192 | 5.0638142 |
| **Odds Ratios for Highest Education Qualification Attained (Higher Education = Diploma & Degree & Postgraduate. Lower Education = Others)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Lower Education | Higher Education | 0.6088106 | 0.4055 | 0.1891123 | 1.9599491 |
| Higher Education | Lower Education | 1.6425468 | 0.4055 | 0.5102173 | 5.2878645 |
| **Odds Ratios for Employment Status (Student. Others)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Student | Others | 1.140224 | 0.8129 | 0.3846367 | 3.380101 |
| Others | Students | 0.8770207 | 0.8129 | 0.2958491 | 2.5998562 |
| **Odds Ratios for Household Monthly Income (Higher Income = above $5,000. Lower Income = $5,000 and below)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Lower income | Higher income | 0.2951265 | 0.0352* | 0.0947705 | 0.919059 |
| Higher income | Lower income | 3.3883775 | 0.0352* | 1.0880694 | 10.55181 |

Normal approximations used for ratio confidence limits effects:
Age
Highest Education Qualification Attained (Higher Education = Diploma & Degree & Postgraduate. Lower Education = Others)
Employment Status Household Monthly Income (Higher Income = above $5,000. Lower Income = $5,000 and below)
Tests and confidence intervals on odds ratios are Wald based.

TABLE 4: TECHNOLOGY ANXIETY

| **Effect Wald Tests** | | | | | |
|---|---|---|---|---|---|
| **Source** | | **Npram** | **DF** | **Wald Chi Square** | **Prob>ChiSq** |
| Age | | 1 | 1 | 2.14197456 | 0.1433 |
| Highest Education Qualification Attained (Higher Education = Diploma, Degree & Postgraduate. Lower Education = Others) | | 1 | 1 | 0.2719003 | 0.6021 |
| Employment Status | | 1 | 1 | 1.96851116 | 0.1606 |
| Household Monthly Income (Higher Income = Above $5,000. Lower Income = $5,000 and below) | | 1 | 1 | 0.26567082 | 0.6063 |
| **Odds Ratios** For Technology Anxiety (0=Yes. 1=No) odds of 0 versus 1 | | | | | |
| **Odds Ratios for Age (Above 30. 30 and Below)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Above 30 | 30 and Below | 5.5878066 | 0.1433 | 0.5578868 | 55.967592 |
| 30 and Below | Above 30 | 0.1789611 | 0.1433 | 0.0178675 | 1.7924782 |
| **Odds Ratios for Highest Education Qualification Attained (Higher Education = Diploma & Degree & Postgraduate. Lower Education = Others)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Lower Education | Higher Education | 0.6870484 | 0.6021 | 0.1675961 | 2.8165073 |
| Higher Education | Lower Education | 1.4555015 | 0.6021 | 0.3550497 | 5.9667272 |
| **Odds Ratios for Employment Status (Student. Others)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Student | Others | 3.144749 | 0.1606 | 0.6345794 | 15.584253 |
| Others | Students | 0.3179904 | 0.1606 | 0.0641673 | 1.5758469 |
| **Odds Ratios for Household Monthly Income (Higher Income = above $5,000. Lower Income = $5,000 and below)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Lower income | Higher income | 1.3823004 | 0.6063 | 0.4036019 | 4.7342552 |
| Higher income | Lower income | 0.7234318 | 0.6063 | 0.2112265 | 2.4776892 |

Normal approximations used for ratio confidence limits effects:
Age
Highest Education Qualification Attained (Higher Education = Diploma & Degree & Postgraduate. Lower Education = Others)
Employment Status Household Monthly Income (Higher Income = above $5,000. Lower Income = $5,000 and below)
Tests and confidence intervals on odds ratios are Wald based.

TABLE 5: SELF EFFICACY

| **Effect Wald Tests** | | | | |
|---|---|---|---|---|
| **Source** | **Npram** | **DF** | **Wald Chi Square** | **Prob>ChiSq** |
| Age | 1 | 1 | 8.22621e-5 | 0.9928 |
| Highest Education Qualification Attained (Higher Education = Diploma, Degree & Postgraduate. Lower Education = Others) | 1 | 1 | 0.00005846 | 0.9939 |
| Employment Status | 1 | 1 | 6.64722e-5 | 0.9935 |
| Household Monthly Income (Higher Income = Above $5,000. Lower Income = $5,000 and below) | 1 | 1 | 0.51990127 | 0.4709 |

TABLE 6: SOCIAL PRESSURE AND TECHNOLOGY ANXIETY

| **Effect Wald Tests** | | | | | |
|---|---|---|---|---|---|
| **Source** | | **Npram** | **DF** | **Wald Chi Square** | **Prob>ChiSq** |
| Social Pressure | | 1 | 1 | 16.226568 | <.0001* |
| Technology Anxiety | | 1 | 1 | 0.00041592 | 0.9837 |
| **Odds Ratios** For Type of Experience (0=Satisfying, 1=Dissatisfying) odds of 0 versus 1 | | | | | |
| **Odds Ratios for Social Pressure** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Yes | No | 9.3097391 | <.0001* | 3.1440762 | 27.566521 |
| No | Yes | 0.1074144 | <.0001* | 0.0362759 | 0.3180584 |
| **Odds Ratios forTechnology Anxiety** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Yes | Yes | 0.9862125 | 0.9837 | 0.259724 | 3.7448022 |
| No | No | 1.0139802 | 0.9837 | 0.2670368 | 3.8502406 |
| **Odds Ratios for Employment Status (Student. Others)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Student | Others | 3.144749 | 0.1606 | 0.6345794 | 15.584253 |
| Others | Students | 0.3179904 | 0.1606 | 0.0641673 | 1.5758469 |
| **Odds Ratios for Household Monthly Income (Higher Income = above $5,000. Lower Income = $5,000 and below)** | | | | | |
| Level 1 | Level 2 | Odds Ratio | Prob>ChiSq | Lower 95% | Upper 95% |
| Lower income | Higher income | 1.3823004 | 0.6063 | 0.4036019 | 4.7342552 |
| Higher income | Lower income | 0.7234318 | 0.6063 | 0.2112265 | 2.4776892 |

Normal approximations used for ratio confidence limits effects:
Social Pressure Technology Anxiety
Tests and confidence intervals on odds ratios are Wald based.

TABLE 7 : SOURCES OF CUSTOMER SATISFACTION / DISSSATISFACTION FOR FOOD VENDING MACHINES

| **Satisfying Experiences** | | |
|---|---|---|
| **Group** | **Illustrations** | **Percentage** |
| 1. Solved intensified need | The food canteen was not opened in school and I was very hungry. Luckily, there was a vending machine to order delicious hot food had helped me satisfy my hunger. | 3.61% |
| 2. Better than alternatives | | 93.98 % |
| a) Easy to use | Ordering food from the Chef•in•Box vending machine was a seamless process. | 9.64% |
| b) Saved time | Quick and convenient, take and go. | 14.46% |
| c) Whenever I want | My first time at Chef in a box was when I needed hot food @ 1am. | 6.02% |
| d) Saved money | Affordable. | 2.41% |
| e) Food was good | Food dispensed from this particular machine is top notch! The aroma slithered pass my senses, and I gobbled the food down. | 50.60% |
| f) Good customer service | The service crew was very friendly and she taught me step by step how to use the Food vending machine, if there was no one assisting me, I would feel shy and awkward to use the vending machine. | 3.61% |
| g) New experience | Was just amazed by the machine for the first time. | 3.61% |
| h) Others | It was the first time that I used a Food vending machines and good cutlery were provided | 3.61% |
| 3. Did its job | Went normally, I got my food. | 2.41% |
| **Dissatisfying Experiences** | | |
| 4. Technology failure | Coin got stuck in the vending machine and end up I did not managed to get food | 19.35% |
| 5. Technology design problem | I bought a $4 meal with a $10 note. The vending machine dispensed out $6 change all in IO-cent and 20-cent coins! | 9.68% |
| 6. Customer driven failure | Did not have cash on me and could not use the machine. Ended up having to go to the nearest ATM which is a distance away and went to a coffee shop instead. | 3.23% |
| 7. Food driven failure | The sandwich was horrible and the sauce soaked the whole wrapper. The bread was soggy because of that as well. | 61.29% |
| 8. Others | The plastic wrap that is supposed to seal the top of the packaging was tom. | 6.45% |

| TABLE 8:COMPARISON BETWEEN FOOD VENDING MACHINES AND SST | | |
|---|---|---|
| **Sources of satisfaction** | | |
| | **Percentage1 (Food vending machines)** | **Percentage, (Self-Serving Technologies)** |
| Easy to use | **35.37%** | 16.71% |
| Avoid service personnel. | 7.32% | 3.71% |
| Saved time. | 8.54% | **30.71%** |
| When I want | 19.51% | 8.71% |
| Saved money. | 3.66% | 6.71% |
| Did its job | 10.98% | 21.71% |
| Solved intensified need. | 14.63% | 11.71% |
| | | |
| **Sources of dissatisfaction** | | |
| | **Percentage3 (Food vending machines)** | **Percentage. (Self-Serving Technologies)** |
| Technology failure | **41.46%** | **47.25%** |
| Technology design problem | 32.93% | 21.25% |
| Service design problem | 14.63% | 23.25% |
| Customer-driven failure | 10.98% | 8.25% |

| TABLE 9: ATTRIBUTION OF EXPERIENCES | | |
|---|---|---|
| **Nature of attribution outcome** | **Type of experience** | |
| | **Satisfyng. Percentage,** | **Dissatisfying, Percentage** |
| The vending machine | 44.83% | 66.67% |
| My own action | 8.62% | 4.17% |
| Both the vending machine and my own action | 29.31% | 16.67% |
| Neither the vending machine nor my own action | 17.24% | 12.50% |

TABLE 10: FUTURE BEHAVIOURS (FEEDBACK)

| Feedback | Type of experience | | Total, Percentage9 |
|---|---|---|---|
| | Satisfying, Percentage % | Dissatisfying, Percentages % | |
| Yes | 12.20% | 6.10% | 18.29% |
| No | 58.54% | 23.17% | 81.71% |

TABLE 11 : REASONS FOR NOT PROVIDING FEEDBACK

| Reasons for not providing feedback | Type of experiences | |
|---|---|---|
| | Satisfying, Percentage % | Dissatisfying, Percentage% |
| Tedious feedback process | 4.17% | 15.79% |
| Time consuming | 14.58% | 26.32% |
| Unaware of feedback channels | 29.17% | 42.11% |
| Do not have any feedback | 47.92% | 10.53% |
| Others | 4.17% | 5.26% |

TABLE 12: ONE-WAY ANOVA

| | F Ratio | Probability, | Mean3 | Standard Deviation |
|---|---|---|---|---|
| **Future Behaviour (Recommendation and Repurchase)** | 31.0915 | <.0001 | | |
| Satisfying Experience | | | 5.15517 | 1.40552 |
| Dissatisfying Experience | | | 3.27083 | 1.35918 |
| **Recommendation** | 32.1095 | <.0001 | | |
| Satisfying Experience | | | 5.13793 | 1.53838 |
| Dissatisfying Experience | | | 3.04167 | 1.48848 |
| **Repurchase** | 25.2763 | <.0001 | | |
| Satisfying Experience | | | 5.17241 | 1.36546 |
| Dissatisfying Experience | | | 3.50000 | 1.38313 |