

Real-time information provisions towards more integrated rail-bus systems in Malaysia

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1 Introduction

The issues currently faced by many public transport systems concerned largely with the lack of integrations among various modes. One such area of integration is information provision for these modes. This paper deals with a research on real-time information provision on-board rail services. It utilises empirical findings from surveys on users' behaviours and preferences towards feeder buses during rail service disruptions. It also discusses the disparity between the existing state of provision of information by the operators and the needs of users, which are typically encountered in developing cities such as Kuala Lumpur.

In developing countries, users' responses towards integrated multi-modal public transport information have not been widely and thoroughly explored. The majority of studies on the impacts have been centred on pre-trip and at-stop or terminal information provisions (Powell, 1993; Lyons, 2005). Additionally, intercept survey methods, especially on moving public transport vehicles, have been sparsely adopted. Hence, limited reference can be made on the impacts of information provision regarding disruption of services on-board public transport.

The research is on the new attempts at capturing data on-board public transport vehicles. The main advantage is that reality-based environment with which passengers normally associate their travel experience can be embedded. Another advantage is that the related biasness of stated preference studies and hypothetical scenarios testing can be reduced. This paper discusses the findings of the impacts of introducing integrated information to rail users in a developing region namely *Klang Valley*, Malaysia. These respondents were selected on the basis that they required information to transfer within the multimodal transport networks.

The rail industry in Malaysia has a relatively short history. The first electrified rail commuter service only started in 1995. The information system today has not changed much from when it was first developed. A collaborative work with the rail service provider (*KTM Komuter*) was conducted to improve the passengers' information systems. In this regard, the main researcher has also been involved in discussion with the management teams of *KTM Komuter*, to identify the long term plan of information systems enhancement. The research addresses the major shortcomings of public transport information provision and attempts at bridging the gap in the literature. In essence, the paper discusses the influences of Passenger Information Systems on mode choice decisions under various scenarios. The information has been hypothetically provided through three media types: audio, written text and visual still-graphic presentations, on-board moving trains.

2 Public transport information

The influence of information on public transport users' travel decisions have been investigated by utilising empirical evidences (Lyons, 2005; Wall and McDonald, 2007). The impacts could be positive such as reductions in the overall journey time and the burden of waiting (Reed, 1995). Other benefits were improved reliability of public transport services,

removal of uncertainties of travel, increased patronage of prospective and captive users and modal shifts from private vehicles (Vencatachellum, 2002; Banister and Stead, 2004). In contrast, information utilisation may also be detrimental to public transport systems and usage as discussed by Abdel-Aty and Abdalla (2006). They argued that bus users who were exposed with various types of information including in-vehicle information devices have shown some tendencies to shift mode towards private car use. In addition, cases like the Croydon tram link (in the UK) has shown that information provision has led to a negative impact on modal choices (Ahern, 2002). Inaccurate information provision can be worse than no information at all, resulting in declining confidence towards public transport services (Lodden, 2002). These findings implied that the overall impacts of information provisions has been inconsistent, inadequately rationalised and thereby warrant further investigations.

Empirical evaluations of Singaporean (Lim and Garg, 2002), Korean (Park, 2000) and Turkish (Bilgic and Yaliniz, 2005) case studies concluded that the prevalent states of imperfect public transport information in many transitional and developing cities. The situations persisted despite the large amount of resources invested in the rolling stocks and the high level of patronage that public transport can potentially attract. Extensive studies on the impacts of information in developing countries have been limited, with a few exceptions. This calls for more discussions of whether and the extent of public transport information provision influenced mode decision making processes.

2.1 International initiatives

This subsection discusses the existing research on public transport information, focusing on the initiatives undertaken in the more developed nations. Walker (1998) argued for the existence of inertia, usually against switching to public transport modes. He concluded that regardless of information availability, those who did not which to use public transport would not do so anyway. Behavioural inertia has also been discussed by Fujii and Kitamura on their study of Japanese commuters (2003). Brewer and Hensher (2001) discussed the variation of results between stated and revealed behaviours of mode switching as a result of public transport improvement. The incoherent behaviours are, thus, investigated further through intercept surveys adopted in this particular research.

Effects of real-time information suggested that the provision to both users and non users would reduce their uncertainty, thereby avoiding frustration with the services (Caulfield and O'Mahony, 2007). Safety information and risks of public transport were additional types of information sought by users during a trip (Litman, 2005). The needs for congestion information and systematic handling of incidents and disturbances have also been discussed (Kenyon *et al.*, 2000). McLay (2000), in his study of breakdown scenarios, identified that passengers' recovery of the situation, namely their attempts to continue with a journey, depended on the types of trips, the individual characteristics and the role of information.

According to Hall *et al.*, (2005) interchange or transfer information has been requested by 10% of users. Tam and Lam (2005) asserted that willingness to pay for transfer and interchange information was influenced by the timeliness and quality of information. Walker (1998) found that the acquisition of information could be affected by instability of the services. Information is highly relevant when service reliability is a major concern, because in many developing countries reliability is relatively lacking. An Austrian study found that one in five people surveyed would use alternative modes if there had been access to information for multimodal journeys (Rehrl *et al.*, 2007). Additionally, even the most informed users would seek whole-journey integrated information for all the modes involved (Lyon, 1999). Integrated information, for instance on alternative mode, may influence mode choices (Curtis and James, 1998). Selection between different public transport modes including buses can also be induced by weather (or heavy rain) conditions (Abdel-Aty and Abdalla, 2006) and culture (Nordbakke and Ruud, 2005).

This research aims at evaluating the effects of integrated information in the context of developing countries. In many developing cities, public transport services levels are often limited by different micro-climate and cultural settings that are absent in most studies of advanced systems found in the industrialised nations.

It is essential to distinguish between the information supplied from what the users perceived as useful and meaningful. Transport managers may provide, say, bus information regarding headways at bus stops. However, this information may lead to different interpretations or misconceptions by users, for examples, as absolute waiting time (Avineri, 2004). In particular, the research emphasises the mismatched supply and needs of information on-board public transport. An evaluation of on-board information is important because it is the stage where passengers have the least control over the journey.

2.2 Australian initiatives

A number of initiatives to ensure passengers yield the greatest benefits from real-time public transport information have been cited in many studies and contemporary literature. Some have been conducted in European, Northern American and Japanese cities. There are also initiatives undertaken in Australia. The Yarra Tram Trackers real-time information system (www.yarratrams.com.au/), Adelaide Metro tram supplementary feeder bus stops information system and real-time departure countdown information at Adelaide's SMART STOPS (www.adelaidemetro.com.au/) are three of these examples. Findings of the impacts of these systems can be used to support initiatives in developing cities, e.g. Kuala Lumpur.

3 Effects of information variations

The impact of information provision, in the cases of delayed rail services, should be generally positive to ensure its viability. A highly anticipated effect is the retainment of existing passengers and a reduction in the share of those switching to private vehicles as alternative modes. The real-time integrated information hypothesised in this research was an introduction of feeder services to transfer affected users to the nearest alternative routes.

In this paper, the perceived effectiveness of public transport information is examined against different dissemination media and delay durations of the rail services. It aims at providing a better understanding of how users react towards multi-types of information. The assessment is concentrated on estimating the share of passengers indicating their preferences for supplementary feeder services.

3.1 Research methodology

The research adopted two methods perceived as most suitable, following deliberation on several limitations of the existing available methodology. Some of these limitations are also cross-referenced in the discussion section. Considerations have been made of the nature and uniqueness of the case study. The case study is a developing city which has only recently been introduced to integrated light-rail and feeder bus services. The absence of integrated transfer points and ticketing systems with the heavy-rail commuter services would deem some methods applied in studies of advanced system unsuitable. For instance, the household surveys would not be viable to capture data on public transport users' behaviour since only less than five percent of the population use public transport modes and smaller proportion would have any experience interchanging between many public transport modes.

In addition, a very negligible proportion of residential areas have high accessibility to rail-based transportation. Interchanges between rail services and other public transport modes are limited to several stations and termini. In *Klang Valley*, there exists no integrated ticketing

system between the suburban commuter rail system and other modes. Buses and rail travels are seen as inferior to private vehicle journeys. Many users were low-income earners, often captive to a particular transport mode. There also exists no differentiation between express, semi-express or local services in the rail system. The current system runs at different frequencies for both peak and off-peak periods. Operator faced budget deficit and decreasing subsidies from the government. In particular, rolling stocks have not been overhauled and replaced since the first inception of services some 13 years ago. Currently electrical multiple units (EMUs) run on the century old metre-gauge tracks.

Passengers in developing cities especially in Malaysia found it difficult or uncomfortable to express their views on quality or level of services, and most importantly in quantifying them. As such, probing into value of time, accessibility, safety, security, convenience and reliability has been a great challenge in public transport research. Latent variables of service levels and personal attitudes or perceptions were difficult to extract from user surveys, without providing some level of comparisons or benchmarks, as they can vary dramatically from one respondent to another. Hence, questions were limited so as to reduce duration of surveys and burden on cognitive efforts. Moreover, the service provider is operating as a semi-private organisation, being directly subsidised by and managed under the purview of the Ministry of Transportation of Malaysia. It is also worth mentioning that while several initiatives have been carried out to integrate all systems, transportation matters are currently handled in fragments by at least 13 departments or government agencies.

The services are declining and situations are worsened by the none-existence of detailed information regarding delays and alternative modes or routes. Capital investment in information systems is not perceived as a priority. Most users, including regular commuters, were not well versed with scheduling of the services, but would generally acknowledge that services were often subject to delays. Currently information is limited to scheduled departure and arrival time. Information is provided in written forms e.g. service leaflets and static LED displays at platforms. Additionally, a number of stations may be staffed for purposes other than providing information during delays (and mostly to control and manage overcrowding during peak hours). In the absence of all the sophisticated and advanced information systems, the research has opted to undertake an intercept survey to capture users revealed and stated preferences for alternative or substitutive modes during service delays.

The selection of intercept surveys on-board rail vehicles with hypothetical scenarios of delays was made based on the case study's circumstances. As such, the study's findings may be generally relevant with public transport systems that have similar traits but the applicability may be limited when dealing with the more advanced systems. On-board surveys carried out were to ensure that users surveyed respond to the questionnaire in an environment that reflected the reality of their travel experiences, with minimal disturbance to their well-being.

Hypothetical delay information and media through which the information was conveyed were designed to match, as close as possible, situations faced by a typical journey with service disruptions. Information was prescriptive in nature to ascertain discrete mode and route choice decisions. The audio information was pre-recorded using an actual announcer's voice, according to the routes of the rail services. The variable message used was disseminated via a mobilised two-line LED display unit, carried on-board the selected train journeys. The graphic information was suited to the feedbacks of the pilot surveys. Frames of still-graphic presentation were selected over moving 3-D video presentation due to considerations of duration of surveys and negative effects such as traumas suffered from watching the sample of train derailment video. Respondents were selected based on systematic sampling at selected stations/termini with interchanges facilities. Both peak and off-peak services and routes were boarded to include all journeys types and durations.

3.2 Case study

A case study was conducted to illustrate the differing impacts information media on travel decisions. *Klang Valley* is currently served by five rail-based public transport services. At present only the two light-rail services are supported by and integrated with feeder buses. *Klang Valley's* feeder service was a priority programme within the overall transportation system planning. In the revamp initiatives of massive local bus network, the city shuttle services were launched in late 2005 with 160 buses using 15 routes on the main roads of the central business district (CBD). The feeder system connected five hubs in the city with the CBD. It was envisaged that the networks be extended to cover more areas by the end of 2007. There was no feeder system servicing the routes during the survey period.

The commuter rail services consist of two routes traversing the region in four major directions. The combined *Sentul-Port Klang* (east-west) route and *Rawang-Seremban* (north-south) route have 42 stations covering some 150km distance. In the absence of a fully integrated public transport system, it is timely that the feeder bus demand be assessed. Additionally, future investment in information provision regarding the availability of feeder services can also be evaluated. However, a limitation related to the adopted method of stated preference surveys should be highlighted. For instance, passengers would have to express their decisions based on the quality and attributes of the existing feeder buses when stating their preferences in the questionnaire. As such, an issue of biasness is introduced because the assessment of prospective responses is subject to methodological and analytical drawbacks pertinent to the selected method. Nevertheless, it was agreed that this was an opportunity to strengthen the systems of services and information deliveries, and thus contribute to the overall initiatives to integrate public transport systems in the region.

In the preliminary analysis, the focus was on mode switching behaviour or decision making. Passengers travelling between the months of January and April 2007 were considered as the population, from which a sample of 600 users were identified as respondents. After data cleaning (of 583 initial cases) of refusal and incomplete questionnaire, 537 cases were considered as valid responses. The objectives were to ascertain whether and the extent to which the information provided influenced mode switching decisions. To test the hypothetical events of delays and varying information media, users were asked to assess the usefulness of the information, in terms of prescribing an alternative mode under the circumstances. To this end, respondents were requested to undertake the followings:

1. To listen to a playback of voice recording indicating the delay duration and reason, and prescribed alternative modes and routes.
2. To read a scrolling multi-line variable message sign (VMS) consisting information on delay duration and reason, and prescribed alternative modes and routes.
3. To view a movie depicting the reason for and duration of delay. Users were also requested to consider the alternative modes and routes previously conveyed.

In the pilot survey, the 3-D movie was presented in various screen sizes including laptop, mp3 players, digital cameras and mobile phones. It took more than 20 seconds.

The preliminary findings indicated users were (significantly) indifferent to the screen sizes but complained about the length of the movie and the potential traumatic effects it has on some of them. Based on these feedbacks, in the actual survey frames of still-graphics were chosen to replace the 3-D fly-through movie. It was also assumed that passengers could comprehend the messages conveyed regardless of presentation manners.

Two of these frames are shown in Figure 1 and Figure 2.



Figure 1 – Still-graphic picture of rail conflict Figure 2 – Still-graphic picture of EMU derailment

3.3 Descriptive statistics

Of the 537 respondents, 51% were male. More than half were between 21 and 30 years of age. Almost half earned below the national average monthly household income of RM2000 (USD570). About 46% had attended or were enrolled in tertiary education and nearly 70% were residing in urban areas with moderate or high accessibility to public transport services. Nearly half of the respondents were having either origin or destination in work or educational places (i.e. commuting). About 46% did not own a private vehicle while some 35% did not have any access to a private vehicle; which explained the mode captivity mentioned in sub-section 3.1. Socio-demographic characteristics may have some bearings on the biasness introduced in the analysis of results.

3.4 Effects of delay duration on feeder bus and rail modes

The delay duration information was tested to predict the changes in mode choice of users. Figure 3 shows the possible alternative decisions made by users during services delay of 60 minutes. The categories have been collapsed into three from six which have been outlined in the questionnaire. 54% respondents who listened to the audible information opted to remain with the rail modes or change their original departure time. In other words, they would wait until the services resumed to normal. The proportion of users willing to wait has reduced to 52% when text information was provided. It declined further to 43% when visual message was presented. It can be concluded that as information was gradually upgraded from audio to text and from text to visual, comprehension of the messages increased and better information regarding continuing journeys helped improved travel decisions. Similar patterns were also recorded for delays of 45 and 30 minutes. The corresponding percentages for 45-minute-delay were 61% (audio) to 60% (text) to 52% (visual). For the 30-minute-delay scenario, the figures were 80% (audio) to 78% (text) to 65% (visual). It is noted that as delay decreased, the proportion of respondents willing to wait or remain using rail mode increased.

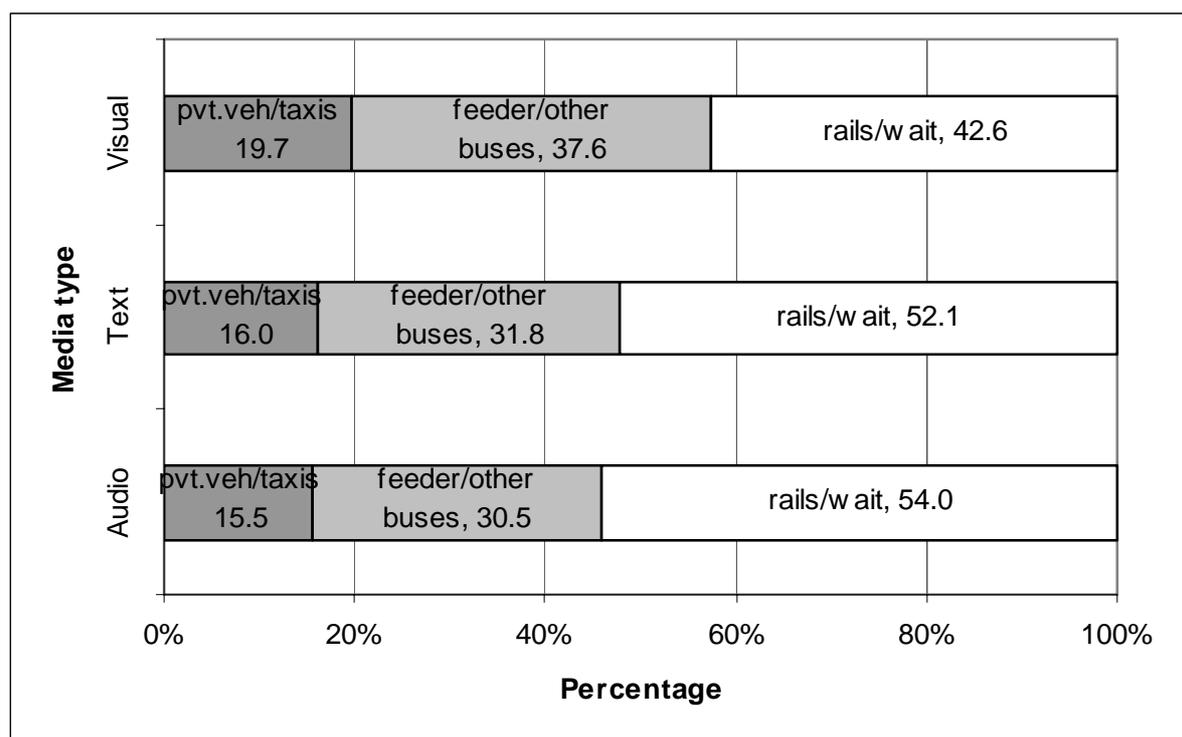


Figure 3 – Mode choices for 60-minute delay by media type

A statistical significance test was also carried out to compare the magnitude of impacts at different delay durations. A paired-samples t-test was used to compare changes in mode share under different scenarios when gradual improvements in media were introduced. There was no statistically significant increase (at 95% confidence level, $p = 0.07$, $t(3) = -3.6$) in the proportion of decision changes for rail mode between the reduction of delays from 60 to 45 minutes (mean = 8.2%, standard deviation = 1.8%) compared to from 45 to 30 minutes (mean = 16.7%, standard deviation = 3.0%). The magnitude of the difference in the mean was, however, large (eta squared = 0.86). Hence, there was a considerable change in the share of rail modes when delay was reduced from 60 to 45 minutes relative to when delay was reduced from 45 to 30 minutes, but was only significant at 90% confidence level.

A similar test was conducted for “feeder buses”. It was found that reducing delay duration from 60 to 45 minutes (mean = -5.6, standard deviation = 0.05) has resulted in no significant change (p value = 0.08, $t(3) = 3.2$) in decision compared to a reduction from 45 to 30 minutes (mean = -10.0, standard deviation = 1.9). The magnitude of eta squared was 0.78, indicating a large difference. Hence, it can be concluded that for both mode choices, at 95% confidence level, delay durations has no significant impacts in decision making process.

3.5 Effects of information media on feeder bus and rail modes

The impact of variability in information media was evaluated to model the changes in mode selection decisions. Figure 4 and Figure 5 depict the respective changes in mode choices for “rail or wait” and “feeder buses” when improvements of media were made under different delay circumstances. It is worth noting that the figures represent changes in decisions for that particular category rather than the absolute proportion of respondents selecting the mode choices. The percentage changes for “rail or wait” category were negative, because under normal circumstances, improving information media increased the comprehension level and added values to decision making quality. It is also intuitive that an upgraded information media would induce respondents to opt for feeder buses as an alternative to waiting in situation of services delay, thus the positive percentage changes.

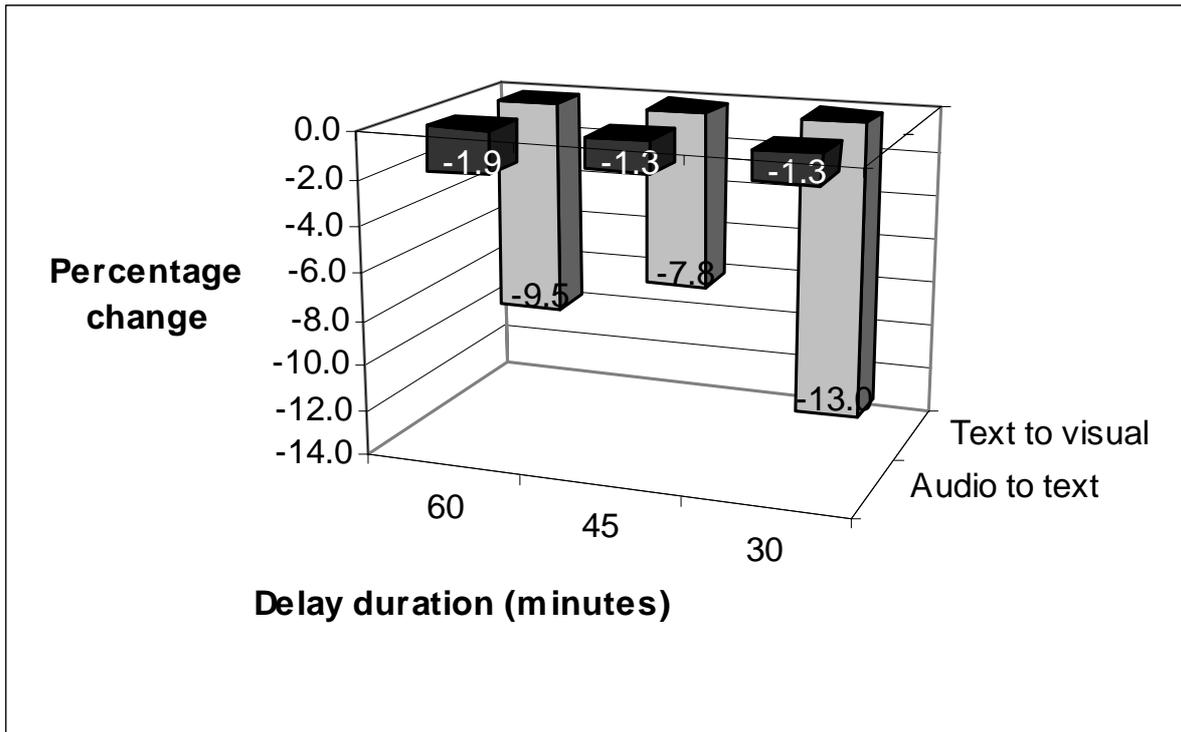


Figure 4 – Changes in "rail or wait" mode choice decisions by media improvements for different delay durations

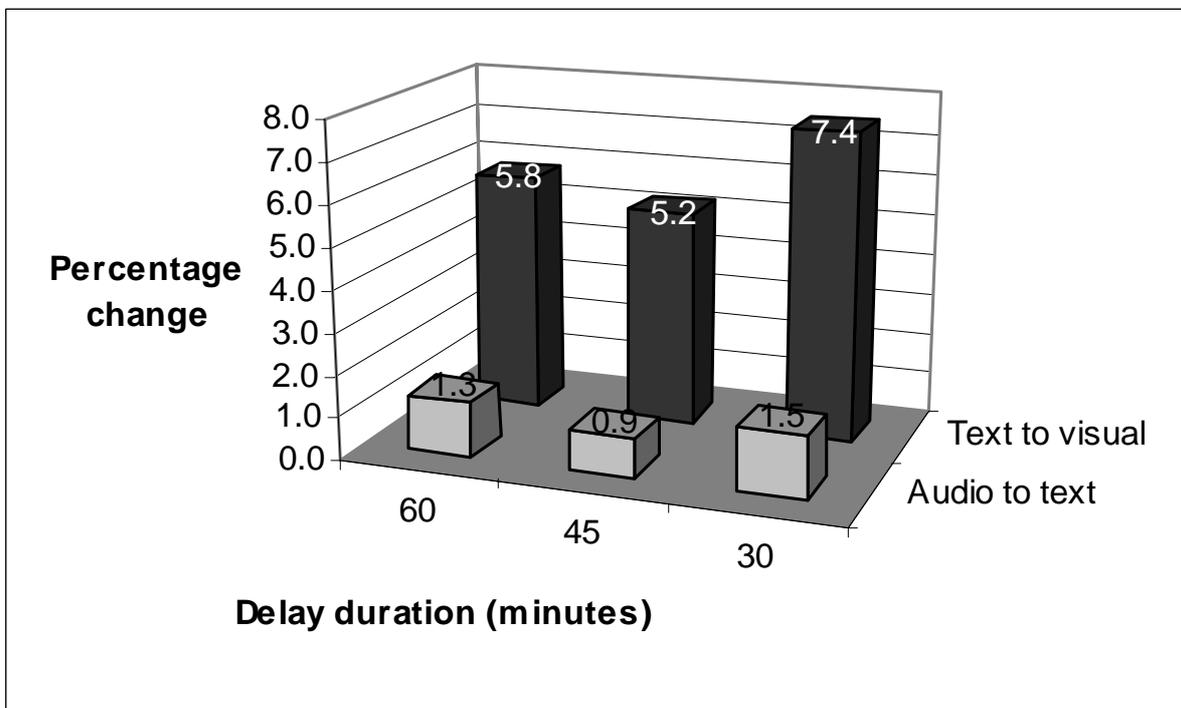


Figure 5 – Changes in "feeder bus" mode choice by media improvements for different delay durations.

The changes were less dramatic when the text message was introduced compared to when visual information was introduced. Paired-samples t-test conducted produced interesting results. Upgrading the information media from audio to text has lesser impact in terms of decision changes (mean = -1.5, standard deviation = 0.3) compared to when information was enhanced from text to visual (mean = -10.1, standard deviation = 2.7), which is significant at 95% confidence level (p value = 0.03, $t(3) = 5.4$). The eta squared value of 0.94 indicated a large magnitude of differences between the two changes' mean. It can be inferred that improving information media can induce better decision making in the form of less waiting time for services to resume and higher proportions opting for other alternatives.

The variation was also significant for "feeder services". Increased decision changes were highly evident (p value = 0.01, $t(3) = -9.2$) when information was improved from text to visual (mean = 1.2, standard deviation = 0.3) compared with the upgrading of audible to textual information *per se* (mean = 6.1, standard deviation = 1.2). The magnitude of the differences in the means was also large (eta squared = 0.98). Therefore, it be concluded that enhancing the dissemination media can influence the demand for "feeder buses" especially when messages were conveyed graphically or using pictures.

3.6 Effects of information media on other mode choices

The results for other mode choices, such as private vehicles, taxis, trip abandonment, direction reversal and rail route changes, varied slightly. They were somewhat inconsistent that limited meaningful analysis can be carried out. For example, at 30-minute delay, audio information would induce some 5.6% of the respondents to select these choices but the share would decrease to only 5.4% if information was conveyed through VMS. Instead, when the messages were displayed in graphical form, there was an increase in the proportion of those opting for these choices to 11.0%. Hence they were collectively grouped as "private vehicles/taxi and other modes" category. The patterns showed that reductions in the shares of these categories were more substantial when the VMS was replaced by visual information compared to when audio information was upgraded to that of textual. The trends in travel directions and routes were also not clear. In situations of different delay durations, varying information media will vary the shares. For example, a reduction in the share of reverse direction travel or riding the trains bound for the station of origin was evident for 45-minute delay scenario but not so for 30-minute delay scenario. There was a reduction in the share if audio information was replaced by variable message sign displays but the reverse was true when changing the textual information with a visual one. Hence, it is suggested that more studies on the effects of delay duration be made with regard to media variation of information dissemination on these travel choices.

3.7 Effects of real-time integrated public transport information

The research has so far discussed the overall effects of hypothetically integrated public transport information provided in real-time. It can be summarised that improving the real-time information media, may to a large extent (based on significant testing) increase the inclination to maintain ridership rates of public transport modes. It can also be implied that the preference for rail-bus transfers during services disruption was evident among existing users, given the hypothetically integrated scenario of these systems. The longer the delay duration, the greater the needs for real-time information and fleets of supplementary vehicles will be. These feeder services may be dispatched and flexibly routed to the unaffected stations or destinations while relevant repair works being undertaken or technical problems addressed. The survey results also provided some important insights regarding users' responses towards integrated public transport information which were useful for both the managers and other policy makers in the field.

3.8 Information provision to transport managers

Face-to-face structured interviews were conducted to ascertain the views of transport managers. According to the managers of the rail company, the existing system has been providing users with delay information. Delays have been contributed either by technical failures, track disruptions or disturbances to the power supply. For relatively shorter delays, information was relayed to passenger by train drivers through the public address system on-board the train. For long delays, notices were put up at stations or terminal at strategic locations. Voice announcements were also made on public announcement systems near ticket vending machines and platform counters. Information on delays was transmitted from the disrupted locations to the headquarters office or the Traffic Control Centre at *KL Sentral* station. This information will also be updated by the respective Station Masters or Managers. Real-time information provision was facilitated by long-line communication and signalling equipments. For persistent extraordinary delays, media releases via print and electronic means such as the radio, television and newspapers were made.

However, the content was limited to the existence of any delay and the reasons for the delay. No other descriptive and prescriptive information was offered. The managers also acknowledged that public address announcements could be unclear due to infrastructure maintenance quality and the none-existence of operational procedures for specific interval of announcements. When inquired about the expected types of information deemed useful by users, managers showed high levels of comprehension and consideration. Generally, managers expected rail users to seek information on the duration of delay, the estimated time when the services will resume to normal, the arrival time of the next available or supplementary trains, alternative modes or routes to travellers' final destinations and other prescriptive information on which *impromptu* travel decisions can be based. However, most importantly, managers viewed that users should be informed as soon as possible. In this respect, real-time information should be disseminated for an interval of 8 to 10 minutes. This interval was calculated based on the headways of rail services.

Moreover, the media thought to be most useful to passengers were voice announcements, notices and visual/textual information. It was stressed that informing on delays *per se* was inadequate. Using information and communication technologies and advanced technological media, passengers should be assured of the availability and reliability of the system. Users, according to managers, would prefer to be informed of the reasons for delay e.g. due to the breakdown of electrical multiple units (EMUs). Awareness of the reason for delay can help users make better and more informed decision for their continuing or connecting journeys. Managers also discussed the planning and development of passenger information systems. However, in the short term, these proposals were not prioritised. There were other issues deemed more important by the managers. One area is the ever-declining annual budget allocation for rail services, since the company is heavily subsidised by the public sector. Priority was made on the addition of new rolling stock and EMUs.

Nevertheless, the company is planning, in the longer term, to provide more sophisticated LCD and TV screen monitors, informing in real-time about delays. Comparative studies have been made with other systems in the region such as in Singapore and Japan. Updated information with useful contents may be relayed in the future through visual means such as LED message boards or displays. The present, single line, pre-programmed static LED boards should be replaced by real-time, multi-line dynamic or variable ones. This is to be supported by effective signalling and communications infrastructure, which interfaces can be controlled by the headquarters and each station manager. Signage at stations e.g. notices should have immediate impacts and be of high visibility and legibility levels. The managers proposed that the existing policies and standardised procedures be regularly reviewed and updated, based on public users' feedbacks.

3.9 Information provision to users

During the survey, qualitative responses towards information need were also collected. The results presented are based on the perceived usefulness of information, rather than from the perspective of willingness-to-pay. Findings of the pilot surveys had indicated that users had difficulties expressing or associating quantitative or monetary values to information provision.

In the questionnaire, users were asked to outline integrated public transport information that would be useful to them. Only 256 of the 537 passengers responded to this questions, whose answers were used as the total valid responses. Table 1 lists the types of integrated information perceived as important and effective to decision making by those who responded.

Table 1 – Types of information preferred by respondents, $n = 256$

<i>Types of information</i>	<i>Percentage of total sample (%) (n=537)</i>	<i>Percentage of responses (%) (n=256)</i>
Delay Information	8.9	18.8
Location / Direction	7.8	16.4
Time of Departure and Arrival	6.7	14.1
Alternative mode	4.8	10.2
Schedule	4.7	9.8
Real-time and announcement	3.7	7.8
Overall journey information	2.8	5.8
Alternative route	1.9	3.9
Facilities and stations	1.9	3.9
VMS on-board	1.5	3.1
Accurate information	0.7	1.5
Safety/security	0.7	1.5
Fare	0.6	1.2
Through staff	0.6	1.2
VMS displays elsewhere	0.4	0.8
Subtotal	47.7	100.0
Non-response	52.3	-
Total	100.0	100.0

Source: KTM Komuter User Survey, 2007

The percentages are provided in two columns to distinguish one which is based on the total sample from another which is based on the total valid responses. Elaboration is made on the proportion of the total sample i.e. out of 537 respondents. Nearly one in ten (8.9%) sought information on delays. Integrated information on stations' location and direction as well as departure and arrival times were also highly sought by users (7.8% and 6.7% respectively).

Other types of information deemed essential in travel decision making processes were alternative mode during services disruptions (4.8%), integrated services schedule (4.7%), and real-time announcements on delays (3.7%). These were followed by information about the overall journey (2.8%), availability of alternative routes and facilities provided at the stations or platforms (1.9% each).

On-board variable message displays were also sought by some 1.5% of the users surveyed. In addition, 0.7% of respondents complained about the inaccuracy of information, usually with respect to the estimated arrival and departure times. It has been acknowledged by many that delays were a major problem and this has not been truly addressed by the current information provision namely scheduling. Other integrated information sought were on the safety and security measures, the fare system, information by attended staff and provision of variable message displays in strategic places.

A descriptive analysis is also made of the type of information requested concerning delays. Table 2 outlines the types of information perceived as important to users. Similar to Table 1, the percentages are also in two forms, in descending order for the 105 valid responses.

Table 2 – Preferred types of information about delay, *n* = 105

<i>Types of delay information</i>	<i>Percentage of total sample (%) (n=537)</i>	<i>Percentage of responses (%) (n=105)</i>
General information on delay	3.9	20.0
Alternative mode available	3.0	15.2
Inform in real-time, within 10 min. of disruption	3.0	15.2
Inform prior to a journey or at platform	1.5	7.6
Location of delay	1.3	6.7
Alternative route available	1.3	6.7
Feeder facilities introduced at next station	1.3	6.7
Estimated duration of delay	0.9	4.8
Accuracy of information to relieve anxiety	0.9	4.8
Reasons for delay	0.8	3.8
Strategies to reduce technical problems	0.8	3.8
Facilities while waiting due to delay	0.5	2.8
Other PT mode situation during event	0.4	1.9
Subtotal	19.6	100.0
Non-delay related information	28.1	-
Non-response	52.3	-
Total	100.0	100.0

Source: *KTM Komuter User Survey, 2007*

About 4% of the total respondents sought general information on delays. This corresponded to some 20% of those who actually requested for such information in the questionnaire. Alternative modes following disruptions were sought by some 3% of respondents. Real-time information about the delays was also importantly perceived by 3% of the users surveyed. For 1.5% of the total respondents, they would like to be informed regarding the delay before embarking on a journey or en-route if they were already at the platforms. The exact delay location, the alternative routes and feeder services availability were perceived as important when contemplating continuing the journey (1.3% each). Delay duration was also considered as useful while accurate information was seen as a means to relieve anxiety (0.9% each). Some 0.8% respondents sought information on reasons for delay. Correspondingly, 0.8% would like to be informed of strategies to reduce the technical problems. Other information needed were regarding facilities provided while waiting and conditions of other public transport modes during service disruptions.

In summary, users need to be updated on the alternatives, possibly on other public transport modes and routes following these incidents. Messages should be conveyed in real-time, a maximum of within ten minutes of the detection of such incidents. Accurate and reliable information is highly regarded. In effect, relevant information is needed to support travel decisions, especially for those who put high values on their trip duration and experiences. Hence, it can be concluded that the information currently provided was insufficient from both the users' and providers' viewpoints. Passengers required more information, especially the comprehensive and useful ones. Both descriptive and prescription information are important. Descriptive information included reasons for delay, estimated time of resuming to normal service conditions and location of delays. Meanwhile prescriptive information covered alternative modes and routes available, estimated arrival time of the next available trains service in both directions and possibility of real-time information updating. These types of information are considered essential for en-route travel decision making processes.

There were conflicting views between users responding to the survey and the managers of the company. Examples are how severe the problem of delay was and how immediate the remedies needed to be acted upon. This may be due to the differing prioritisation of needs and capacity of both parties. It can also be concluded that the disparity between the supply of and demand (loosely reflected by information needs in the surveys) for integrated public transport information in Malaysia, is substantial and prevalent. While public transport situations in many developing cities cannot be fully represented by the survey findings, the discussion of the results and recommendations can be applied in the relevant public transport sub-systems.

4 Discussion

The preliminary findings of the research provided the following insights into the potentials of real-time integrated public transport provision in one of many developing cities. Firstly, provision of information would positively benefit both parties of suppliers and end users. The operators may retain existing passengers or even attract non-users if information has high accuracy and reliability. Users viewed integrated information positively because their decision making were guided by prescription of realistic options and choices. From the survey, it was found that the share of passengers who would wait and remain within the rail services was the highest. While, this is highly appreciated by operators, it can also be partly explained by the high proportion of captive users in the sample (section 3.1). However, waiting for rail services to resume as normal was not economically efficient because commuters lost productive hours and most importantly journeys cannot be completed successfully.

If the effectiveness of public transport information is to be evaluated against different dissemination media and delays, there are some "disturbing" findings in the research. There were a proportion of users selecting to switch to private vehicles and abandon the trip. Users' reaction to integrated information may be counterintuitive from the anticipated effects. The effects of increasing private vehicle use and cancelling of journeys can be explained by the perceived unattractiveness of buses as an alternative mode. These can be non-economical and irrational due to the productivity, enjoyment and utility losses from the suppressed trips. Moreover, a mode switch to private vehicles is not considered as environmentally sustainable.

The potential demand for feeder services has been identified. Fleet dispatching should match the variation in demand during peak and off-peak hours. Further research into modelling this behaviour can be initiated. The current rail services are at 15 and 20 minutes intervals. Supplementary feeder schedule should be planned and routed based on the frequency or headways of rail services. Stations with the greatest risks or threats of disruptions and the

furthest away from other public transport alternatives should be prioritised. The operators would need to overcome the issues of depleting quality of fleet (currently most are reaching their end of lifecycle), rolling stocks backlogs and repairs. Malaysia faced economic downturn and budget deficit at national level for the past few years. As a result, prioritising of physical stock procurements and routes expansion has been favoured; while public transport information provision and integration have been secondary. While the government's policy and priority are on the double-tracking and extension of route northwards of the region, integrated information provision should not be neglected because it lessens the burden of waiting among passengers.

The integration deficiency has caused the lacks of confidence in the systems. Users have indicated in the surveys that while information provision can be regarded as an added value to the existing services, this will backfire if the information was inaccurate, unreliable and inconsistent. Different media through which hypothetical information was provided have been tested. The messages can be adequately disseminated by both audible and written or textual variable messages display boards. However, visual information was received with mixed reaction and its effects of were more varied and far-reaching. Statistical tests indicated that changes were greatest for feeder and rail mode shares when visuals were presented. The derailment movie and its duration have, to a small extent, "traumatised" some users. This could impede the actual objectives of the message. As a result, users reacted in confusions, leading to abandonment of journeys and preferences for not using rail for their future journey.

Several issues need to be raised with respect to the findings. Firstly, the study was limited by the implementation of different information media on-board the commuter rail services. At present, neither the said information provision nor the feeder buses supplementing the services during delay events was in existence. Hence, users were presented with only hypothetical scenarios in the survey. This could contribute to instrument and measurement biases caused by the hypothetical nature of the SP questions. In addition, some responses error may be underestimated because the existence of ordinal effects of information media provisions. In order to minimise users' cognitive efforts, they have been presented to users from audio to text to visual forms and from 60 to 45 and 30-minute delays respectively.

Secondly, various latent factors such as attitudes, perception, spatial abilities, network knowledge and habits studied have not been considered (section 3.1). Variables such as weather, reliability, integration and connectivity of interchanges (Wardman *et al.*, 2001) were not included in the surveys. Differences in sub-population such as ethnicity, culture and nationality, on mode choice and tolerance to waiting have also been ignored (Vigrass and Smith, 2005). In many developed cities, researches on public transport disruptions or delays discussed the tolerated range of 5 to 10 minutes, normally twice the headways of peak hour services (Nossum, 2004; Hollander, 2005). However, in this case study, lateness has been identified for several extremes of 30, 45 and 60 minutes. Finally, it has also been argued that some people just did not like buses (feeders included) (Stradling *et al.*, 2004). Based on the arguments, understanding the behaviours can be a complicated task due to the existence of factors like habits, attitudes, unpredictable decisions, imperfect information or irrational decision making (e.g. abandoning a journey) (Bonsall, 2006).

Delay durations have not (at 95% confidence level) significantly influenced decisions. However, changing of decision or mode switching to feeders and rails has been significantly affected by changes of information media. A 30-minutes delay was deemed bearable by most respondents (four in five users preferred to wait for train services to be reinstated). Users welcome improvements in real-time information dissemination but service providers faced various challenges providing them. Two weeks after the survey, some improvements were noted. Information such as reasons, exact locations and durations of delay was transmitted via the stations' public address system. However, there was no prescribed information on alternative modes or routes.

In general, there exists a mismatch between the supply of and the aspired needs for integrated (multi-modal) real-time information between the service providers and users. Currently, two rail-based public transport services in the region, *PUTRA* and *STAR LRT* under *RAPIDKL* have been integrated with bus feeder services. Feeder services by *KTM Komuter* have yet to be planned. All integration aspects: route, vehicle, ticketing and information, however, fall under the jurisdiction of Ministry of Finance. At present, there are several ministries, government departments and boards handling various issues of the transport industry, each having different responsibilities and jurisdiction over public transportation. This fragmentation of powers and authorities has been identified as one of the various challenges against which public transport services are operated and managed. In its truest sense, there exists currently no integration in the region's public transport systems.

5 Conclusion

The study discussed the responses of user towards incident information provision on-board public transport vehicles. With variables extracted from pertinent literature, it has attempted to assess the sub-modal split in various delay scenarios with differing media of information. While the attempts were to explain these mode choices were often difficult, the study has nevertheless, been able to provide some insights to the complex responses or behaviours exhibited by users of a less integrated public transport system, typical of developing countries. It highlights the mismatch between the supply of and the aspired needs for real-time information of the two parties: users and providers.

It is recommended that real-time information media be developed in the long term, with prioritised investments in variable message signs (VMS) and personal messaging for integrated public transport information. In the short term, public address systems reporting on delay duration and alternative modes or routes would suffice. However, on-board information content requirements may vary according to location. Passengers have indicated that they preferred information on other public transport modes and facilities available while waiting, and to be informed within ten minutes of events. Accurate, timely and prescriptive message means effective information. Enhancing the media proved to increase overall comprehension and lead to better decision making (i.e. utilising feeder services). However, the research also found that delay duration did not significantly influence decisions whether to interchange between rail and bus modes. Users' surveyed had a very high tolerance to delays.

While the study's sometime confusing results may be attributable to the small sample size and limited interpretation of the raw data, in the future works similar to this, larger sample should be obtained to increase the generalisability of the research findings. It is possible to test and implement these results to improve the existing public transport information systems of developing nations, and to incorporate the findings in the dynamic public transport assignment models, in the future. It may also be possible to examine and compare the results when passengers would already have actual personal experience with integrated multi-modal public transport information systems.

The tests of passengers' sensitivity towards delay duration and differing information mediums may assist service providers in planning and developing their information delivery systems. Venues, time and the circumstances during which it is best to relay messages on delay should also be identified. Meanwhile, dispatching of supplementary feeder services should be initiated as an interim strategy while a fully integrated system progressively comes into being. In conclusion, the need for on-board delay information among rail passengers in developing cities has been substantiated. Additionally, this study can be extended to feeder demand modelling and their application to public transport systems in developing countries.

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