

Synthesis of Nickel Nanoparticles in Water-in-Oil Microemulsions

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This is the first successful work in the world on the synthesis of Ni nanoparticles in microemulsions. The synthesis conditions and product properties were investigated completely. Ni nanoparticles have received considerable attention owing to their electric, magnetic, and catalytic properties. In the past, they could be synthesized only in organic solvents under inert gas atmosphere. In this study, Ni nanoparticles were successfully synthesized in the cationic water-in-oil microemulsions of water/CTAB (cetyltrimethylammonium bromide)/*n*-hexanol without the addition of seeds and the input of extra inert gas. The key points include: (1) an appropriate amount of base was added as a catalyst to promote the synthesis reaction; (2) hydrazine was used as the reducing agent, by which hydrogen gas was generated via the reduction of Ni ions and the catalytic decomposition of hydrazine on the resultant Ni nanoparticles to create an inert gas atmosphere for the prevention of oxidation; (3) the reaction temperature was raised appropriately to promote the synthesis reaction. In addition to the establishment of the above key factors, the structure and magnetic property of product as well as the effect of solution composition on the product property were also examined in great detail.

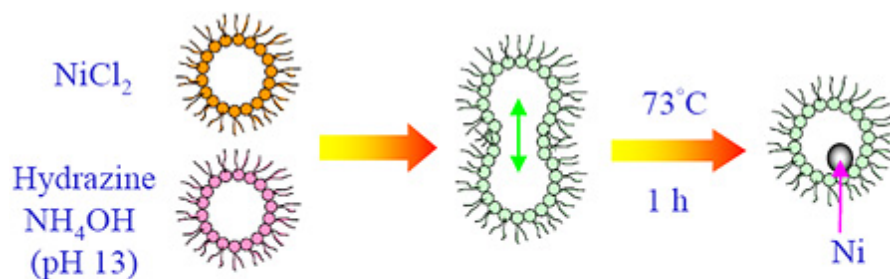


Fig. 1 A scheme for the synthesis of Ni nanopartilces in water-in-oil microemulsions

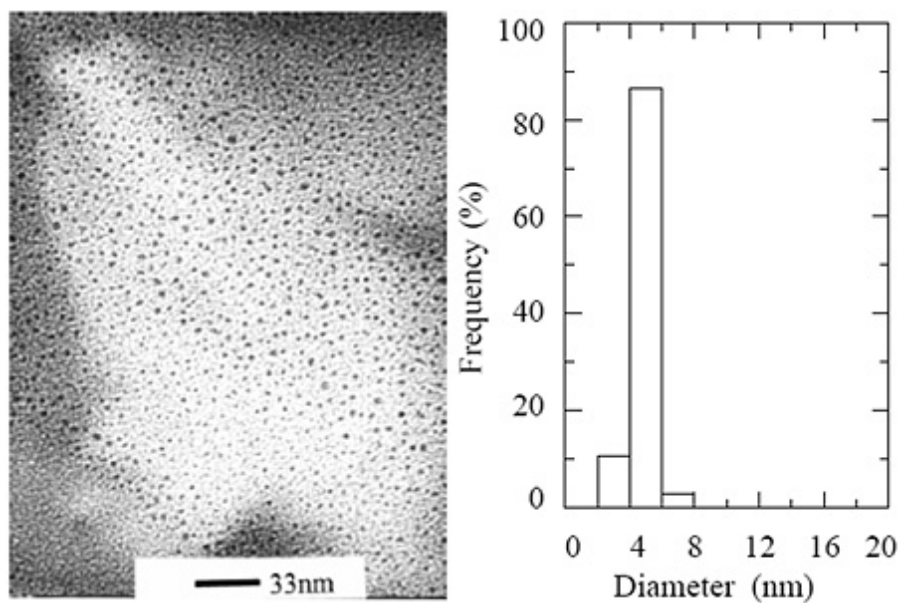


Fig. 2 TEM image and particle size distribution of the Ni nanoparticles synthesized by microemulsion technique. Synthesis conditions: $[\text{NiCl}_2]=0.05\text{ M}$; $[\text{N}_2\text{H}_5\text{OH}]=1.0\text{ M}$; water/CTAB/*n*-hexanol=22/33/45; $73\text{ }^\circ\text{C}$. This figure reveals the resultant particles were very fine and well dispersed with an average diameter of 4.2 nm.

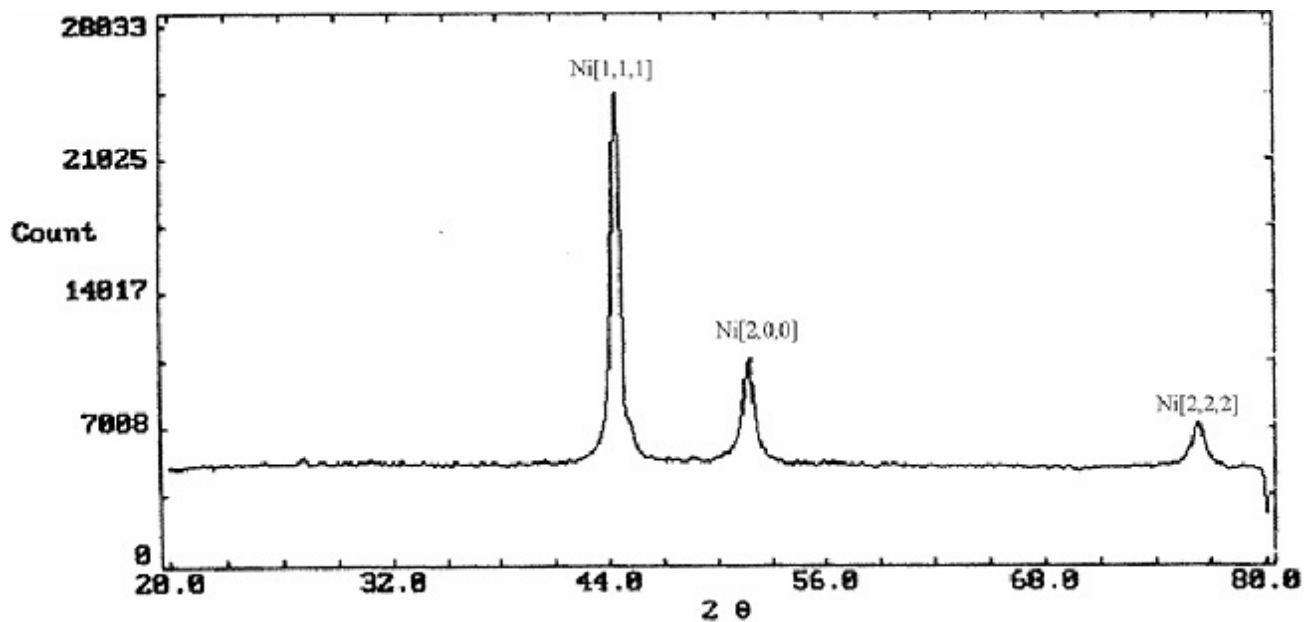


Fig. 3 XRD pattern of the Ni nanoparticles synthesized by microemulsion technique. Synthesis condition: $[\text{NiCl}_2]=0.05\text{ M}$; $[\text{N}_2\text{H}_5\text{OH}]=1.0\text{ M}$; water/CTAB/*n*-hexanol=22/33/45; $73\text{ }^\circ\text{C}$. This figure reveals the resultant particles were pure metallic nickel with a face-centered cubic (fcc) structure. No oxides were formed.

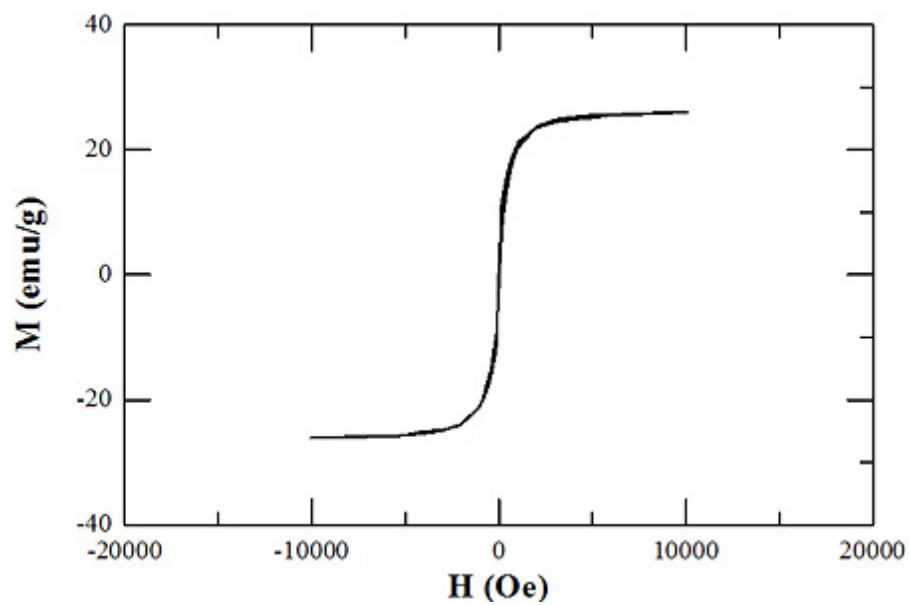


Fig. 4 Magnetic hysteresis curve at 25°C for the Ni nanoparticles synthesized by microemulsion technique. Synthesis conditions: $[\text{NiCl}_2]=0.05$ M; $[\text{N}_2\text{H}_5\text{OH}]=1.0$ M; water/CTAB/*n*-hexanol=22/33/45; 73 °C. This curve reveals that the resultant Ni nanoparticles were superparamagneti with a saturation magnetization of 26.2 emu/g.

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Surface plasmon-enhanced and quenched two-photon excited fluorescence

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Our previous studies have shown that the surface plasmon (SP)-enhanced one and two-photon total-internal-reflection (TIRF) microscopy can increase the brightness and acquisition frame rate of live cell membrane images. In this study, we attempt to identify a suitable spacer between the fluorophore and the metal surface as a trade-off between the fluorescence enhancement and quenching in two-photon excited TIRF microscopy. Therefore, this study investigated systemically that two-photon excited fluorescence is enhanced and quenched via the SPs first. The local electric field enhancement, fluorescence lifetime and quantum yield, and fluorescence emission coupling yield by the SPs with a spacer between the dye and the metal surface are theoretically studied by using the Fresnel equation and classical dipole radiation modeling. Also, a two-photon TIRF microscopy with a time-correlated single photon counting module has been developed to observe the fluorescence lifetime, photostability, and enhancements. From the simulations and the experiments, the trend of the enhancement and the fluorescence lifetimes based on the surface plasmon-total internal reflection fluorescence setup are consistent. We can find that the maximum fluorescence enhancement has been increased up to 30 fold with suitable SiO₂ spacers. The experimental results demonstrate that the configuration with an optimal SiO₂ spacer not only clearly reveals a brighter fluorescent signal compared to that of conventional TIRF, but also improves fluorescence photostability compared to that of a less quenching setup with a thicker spacer.

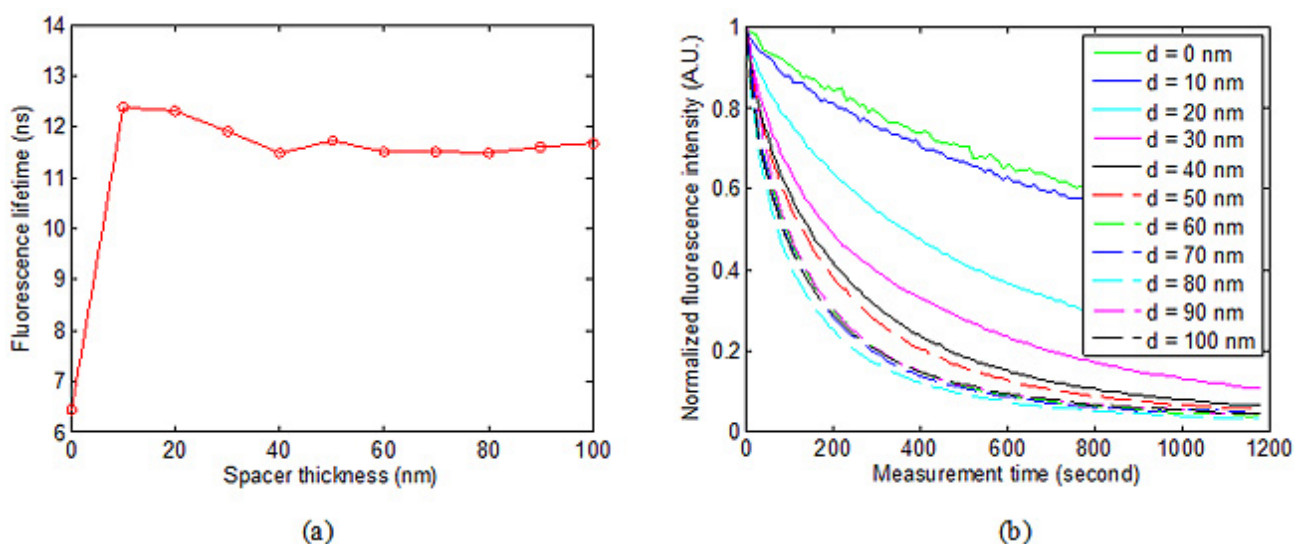


Fig. 1. Experimental results for the fluorescence (a) lifetime and (b) photostability as function of spacer thickness.

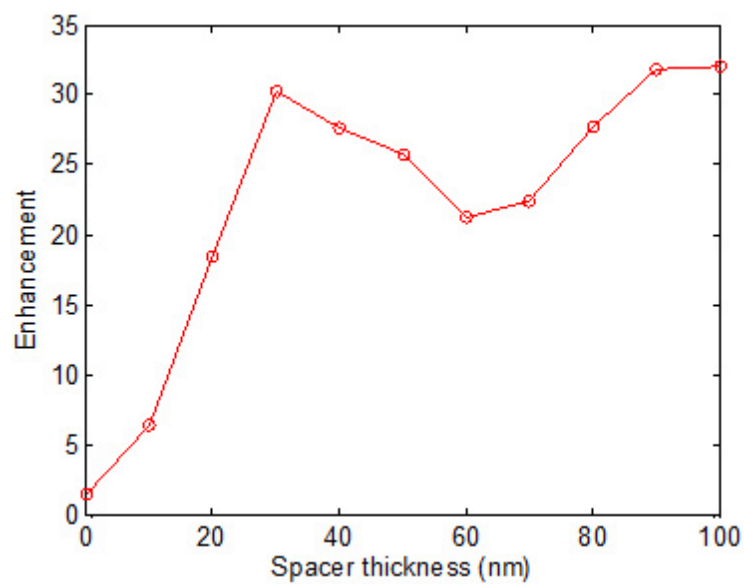


Fig. 2. The overall enhancement factor of the fluorescence intensity as function of spacer thickness.

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Aviation occupant survival factors: An empirical study of the SQ006 accident

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The goal of improving aviation safety involves attending not only to the factors that increase the likelihood of crashes occurring, but also to the factors that increase airplane occupant survivability in crashes that do occur. The main purpose of accident investigation is to discover the causes and related risk factors of accidents and to establish better safety recommendations. Survival-factor investigation focuses on recommendations to increase the survivability of such accidents. The importance of examining occupant survivability in aviation accidents is two-fold: (1) to help dispel the public perception that most aviation accidents are not survivable, and (2) to identify what can be done to increase survivability in the accidents that do occur.



Based on a literature review and the results of expert interviews, we propose a new framework of four major cabin-safety indicators that influence occupant survivability, with details given in Fig. 1: (1) aircraft design and loading (F_1), (2) cockpit- and cabin-crew training and coordination (F_1), (3) passenger behavior and safety education (F_1), and (4) ability to cope with emergencies inside and outside the airport (F_1). Moreover, 47 possible survival factors are generalized and categorized under these four indicators. The Fuzzy Delphi Method is used to identify and rank the survival factors that may reduce injury and fatality in potentially survivable accidents.

To identify factors affecting survivability, we used the modified FDM—a systematic interactive forecasting technique based on independent inputs from 15 selected experts in Taiwan: 11 senior investigators, each with at least 9 years of Aviation Safety Council (ASC) and industry experience; two cabin-safety inspectors from the CAA, each with at least 5 years of experience; and two senior cabin-crew trainers from the flag carrier, each with at least 15 years of experience. We next present an empirical study of Singapore Airline (SIA) flight SQ006 to illustrate the critical factors that influence airplane occupant survivability and compare the ranking score with the FDM group expert consensus value.

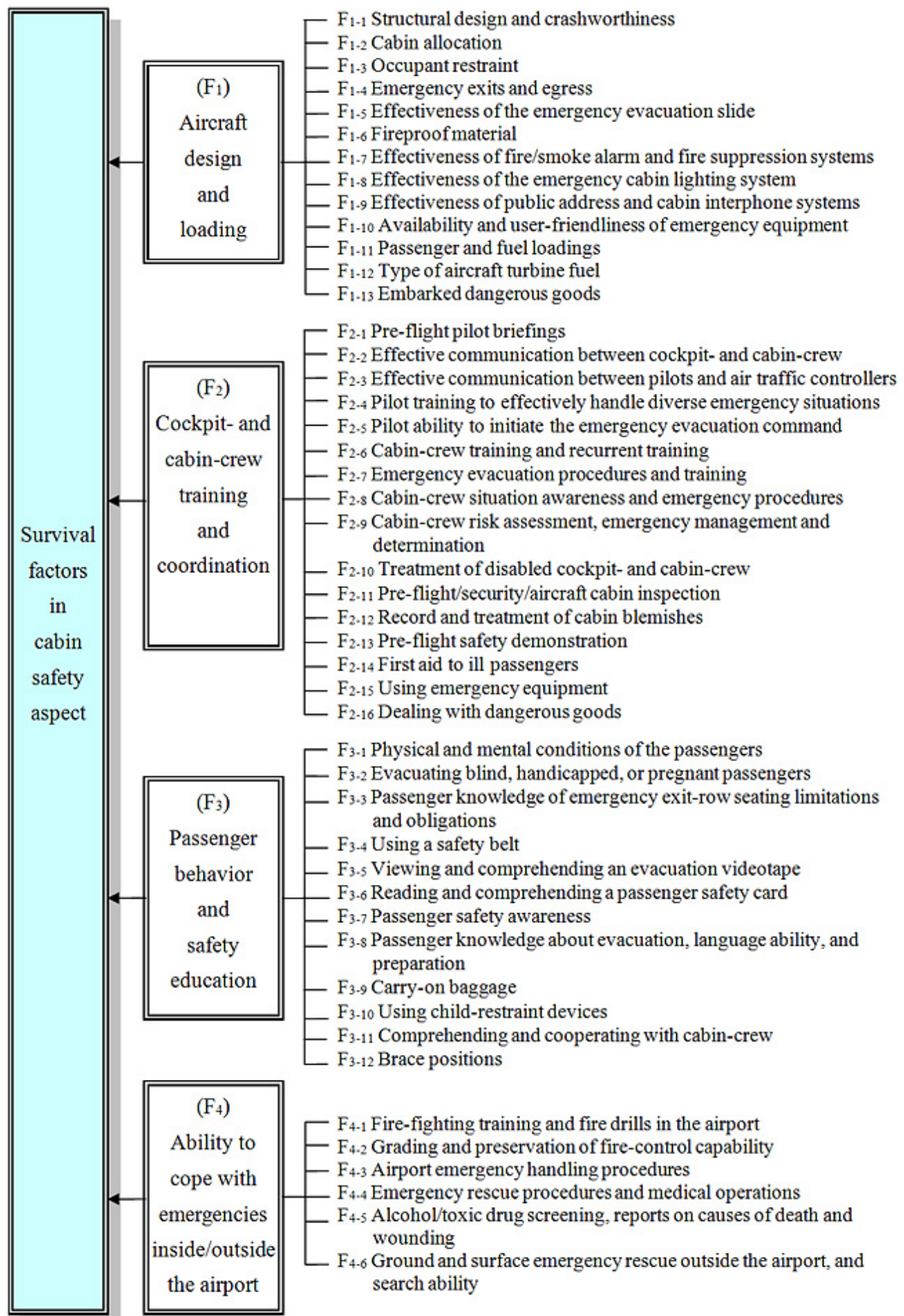


Fig. 1. Evaluation framework for evaluating the survival factors in cabin safety aspect

Ultimately, the survival factors in the SQ006 accident have the same trend as the expert group's consensus values (Fig. 2). Correlations were computed using the non-parametric Spearman's rank-order correlation coefficient test (ρ_s) and Kendall's ranking test (τ_b); both revealed that the group of experts' consensus value was significantly correlated with that of the SQ006 accident investigation team ($\rho_s = .670, p = .000$; $\tau_b = .513, p = .000$) (Fig. 3).

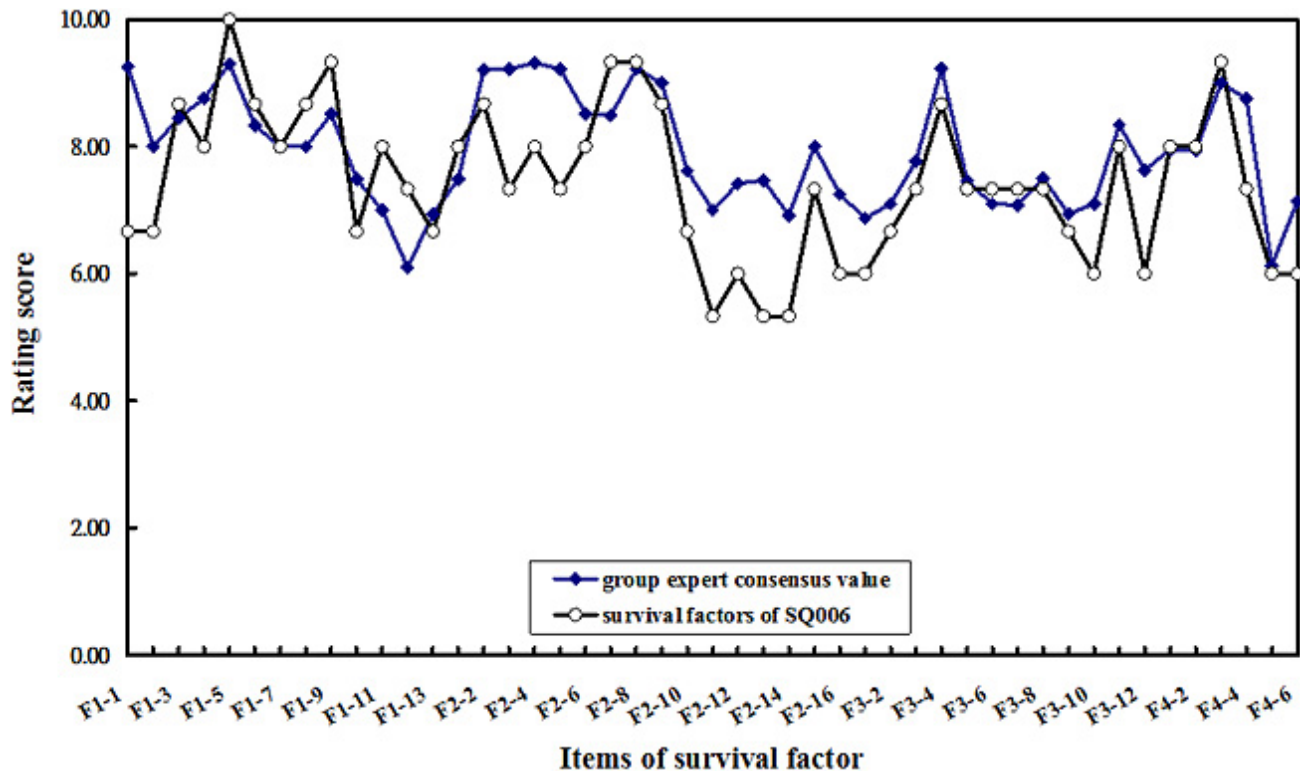
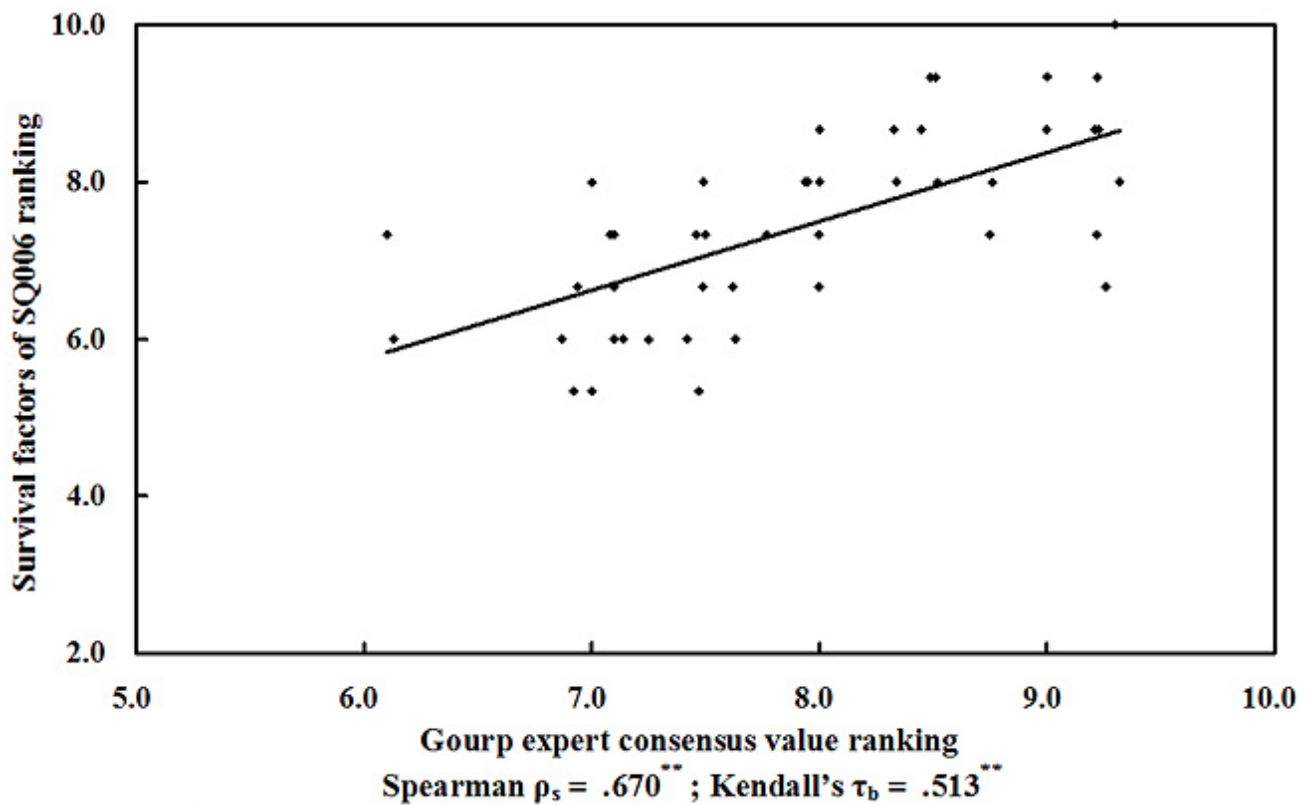


Fig. 2. Comparison of survival factors between the group expert consensus value and the SQ006 accident investigation team



****All correlation coefficients are statistically significant at the 0.01 level (2-tailed).**

Fig. 3. Relationship in ranking by the group expert consensus value and the SQ006 accident investigation team

This is the first attempt by a group from both the public and private sectors in Taiwan to focus on cabin-safety issues related to survival factors. Our findings reveal important cabin safety and survivability information that should provide a valuable reference for developing and evaluating aviation safety programs. We also believe that the results will be practical for designing cabin-safety education material for air travelers. Finally, the major contribution of this research is that it has identified 47 critical factors that influence accident survivability; therefore, it may encourage improvements that will promote more successful cabin-safety management.

Cost Analysis of Short Message Retransmissions

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Short Message Service (SMS) is the most popular mobile data service today. In Taiwan, a subscriber sends more than 200 short messages per year on average. The huge demand for SMS significantly increases network traffic, and it is essential that mobile operators should provide efficient SMS delivery mechanism [1, 2]. Due to user behavior and mobile network unavailability (e.g., the user moves to a weak signal area such as a tunnel, an elevator, a basement, and so on), a short message may not be successfully delivered at the first time. If a short message transmission fails, the SM-SC retransmits the short message to the terminating UE after a waiting period. SMS retransmission may result in huge mobile network signaling traffic and long elapsed times of short message delivery. Therefore, it is essential to exercise an efficient SMS retransmission policy to determine when and how many times to retransmit a short message to the terminating UE. To address this issue, we propose analytic and simulation models to investigate the performance of SMS retransmission in terms of the expected number of retransmissions and the message delivery delay. We also collect measured data from a commercial UMTS system to further analyze the performance trends on SMS retransmission.

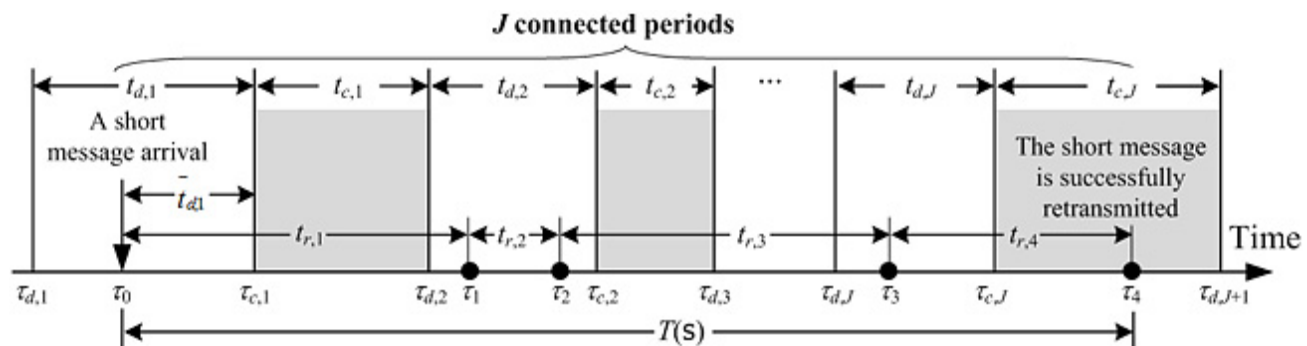


Fig. 1. Timing diagram for the short message retransmissions ($1 \leq j \leq J$)

To simulate the status of the UE availability, a variable UE_STATUS is maintained in the model. When UE_STATUS is set to "On," the UE is connected to the mobile network (i.e., the $t_{c,j}$ periods in Fig. 1) and can receive the short message successfully. When UE_STATUS is set to "Off," the UE is disconnected from the mobile network (i.e., the $t_{d,j}$ periods in Fig. 1) and the message transmission fails. The gamma random number generator is used to produce the connected period $t_{c,j}$, the disconnected period $t_{d,j}$. The SM-SC performs the i th short message retransmission after an Exponential random time $t_{r,i}$ with mean $1=1/\lambda$. Let the expected values for $t_{c,j}$ and $t_{d,j}$ be m_c and m_d , respectively. In an experiment, we simulate N short messages (excluding retransmissions) delivered to the terminating UE. We propose an analytic model to investigate the short message retransmission performance in terms of the expected number of short message retransmissions $E[N(s)]$ and the message delivery delay $E[T(s)]$. Details can be found in [3].

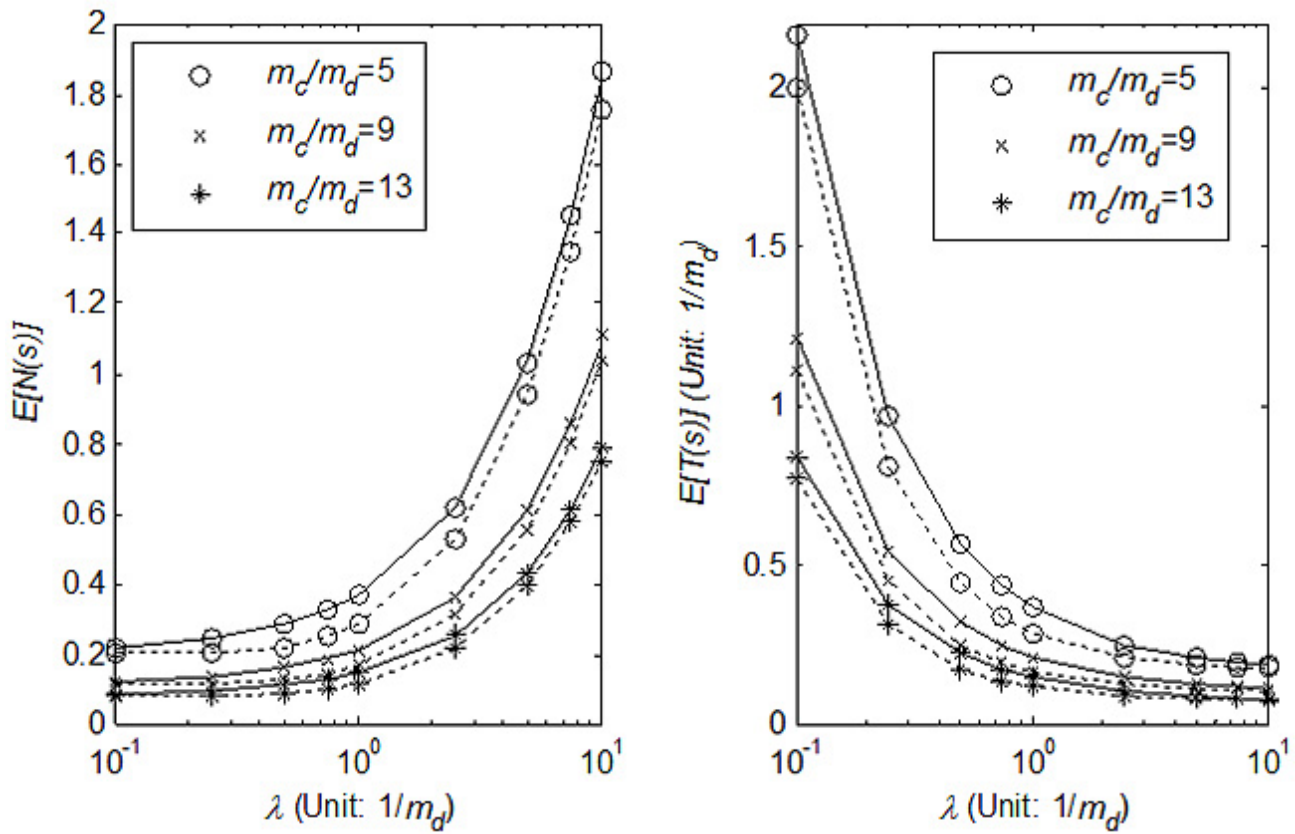


Fig. 2. Effects of λ and m_c/m_d

Fig. 2 shows that $E[N(s)]$ is an increasing function of λ . $E[T(s)]$ is a decreasing function of λ . When $\lambda < 1/m_d$, $E[T(s)]$ significantly decreases as λ increases. Conversely, when $\lambda > 1/m_d$, increasing λ significantly increases $E[N(s)]$, but only has insignificant effect on $E[T(s)]$. We observe that $0.5/m_d < \lambda < 5/m_d$ is the range that both $E[N(s)]$ and $E[T(s)]$ do not degrade significantly when λ changes.

From the commercial UMTS system of Chunghwa Telecom (CHT), we obtained the output measures $\Pr[N(s)=n]$ for several retransmission policies. Define s_{20} as a policy where a short message is retransmitted for every 20 minutes. We have collected the statistics for more than 400,000 SMS deliveries (100,000 deliveries for each policy). Fig. 3 plots the probability mass function $\Pr[N(s)=n]$. Our study indicates that the performance trends for the analytic/simulation models and the measurements from the CHT commercial SMS network are consistent. A useful conclusion is that our analytic model can be used to quickly and roughly estimate the SMS network performance for network planning.

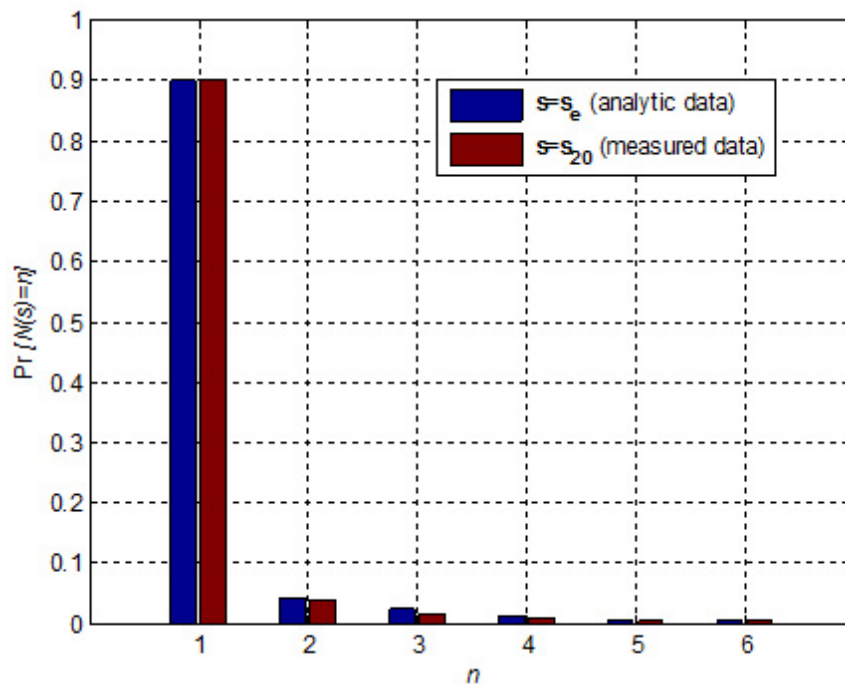


Fig. 3. Performance trends of the analytic data and the measured data

In this paper, we showed how the retransmission rate, the expected values, and the connected/disconnected period distributions affect the SMS retransmission performance, in terms of the expected number of short message retransmissions $E[N(s)]$ and the message delivery delay. Our study indicates that by selecting appropriate retransmission policy (in particular, the retransmission frequency), the SMS delivery cost can be significantly reduced.

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