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Profiling of Child Restraint System (CRS) in the ASEAN Market

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ABSTRACT – *Child Restraint Systems (CRS) are designed for child safety while traveling in vehicles. Accordingly, appropriate CRS is of interest because of its effect on the safety performance of the seat. In ASEAN, the New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP) includes assessments of CRS fitment in the newly tested vehicle model designs. However, there has been no detailed investigation of the CRS availability on the road, despite the dynamic CRS market. Therefore, this study aims to establish a list of the most popular UN R44 or R129 certified CRS in four major ASEAN automotive hub countries, i.e. Malaysia, Indonesia, Thailand, and Vietnam. A market survey was conducted through physical and online platforms to identify the CRS details. The list known as the CRS Reference List was finalized according to the CRS models' availability in at least three ASEAN markets and category variability for the list. This effort is crucial to ensure the CRS reference list remains relevant for the ASEAN NCAP assessment. Thus far, the suggested list supports an effective child occupant injury prevention program that suits a local situation.*

KEYWORDS: Child Restraint System (CRS), Child Occupant Protection (COP), child safety, injury prevention, passenger vehicles

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1. INTRODUCTION

Child Restraint Systems (CRS) play a crucial role in protecting child passengers, during vehicle travels. Properly installed CRS can reduce the risk of injury by up to 70% and the risk of death by up to 80% (WHO, 2017). When children between the ages of 2 and 5 are restrained in an adult seatbelt, their chances of experiencing severe injury including head are more than four times higher and three-quarters higher, respectively, than restrained in CRS (Winston et al., 2000). Over the past two decades, it has been shown that proper CRS usage can reduce injuries while preventing fatalities by 54% to 71% (Zaza, 2001; Lennon, 2012). Proper use of CRS can lower the risk of fatality in car crashes by up to 71% (Starnes, 2005). Another study by Fix et al. (2022) revealed that severe injury was proven statistically insignificant for motor vehicle collisions involving children who belted with CRS. Depending on the children's age, a CRS can be installed forward or rearward facing. Comparatively, Anderson and Peterson (2023) reported that a child aged up to four years restrained in a rearward-facing CRS is 14% less likely to suffer any injury than those restrained in a forward-facing CRS.

To effectively mitigate the risk of serious injuries in the event of a crash or emergency braking, children should be adequately secured for as long as possible while being transported using age or size-appropriate CRS. Fatality Analysis Reporting System (FARS) data analysis for children up to three years old showed that CRS was not appropriately utilized for more than half of the 648 fatally injured children (Lee et al. 2019). In Malaysia, factors like lack of awareness, false perception, and bad experiences of CRS usage due to child reluctance may lead to a lower CRS usage rate (Paiman et al., 2019; Ang et al. 2020). An earlier study conducted by Paiman et al. (2016) revealed that 23.2% of the approached parents were not aware of the availability of upper age limit and different CRS types, particularly for older kids who have outgrown their CRS. Recently, Alsaeigh et al. (2023) also reported a low knowledge of age-appropriate seat types in Saudi Arabia. Surprisingly not only the public, parents

among healthcare professionals also have inadequate knowledge about CRS installation and usage despite their daily public health exposure (Skitek-Adamczak et al. 2022). Several studies suggested that parents' knowledge, motivation, behavior skills (Sun et al., 2023), and education level (Atayoglu & Guner Atayoglu 2023) are proportional to the proper CRS usage. The knowledge level among CRS users is 40.3% significantly higher than non-users (Alsaeigh et al. 2023). These studies exhibit worldwide recognition of the problems associated with CRS proper usage.

Besides public knowledge, CRS weight, attachment type, appropriate fitting to the original seat, child size, etc. are anticipated as factors affecting purchasing preferences. In contrast, CRS price was reported as the most influencing parameter (Frej & Grabski 2023). In line with the goal of ensuring children traveling in vehicles are protected with R44 or R129 certified CRS, the New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP) has been conducting assessments of child occupant safety since its first test in 2012, which include CRS assessment. However, there is a growing number of CRS models available in the ASEAN market with a wide model and price ranges. Figure 1 presents the CRS variables offered in the current ASEAN market. Accordingly, a list of the most popular CRS within ASEAN countries was identified. Therefore, the ASEAN NCAP Child Occupant Protection (COP) protocol will then do a fitment assessment on the identified popular CRS options in the newly tested vehicle model designs (ASEAN NCAP, 2019). The list known as the CRS Reference List (Table 1) contains nine CRS models that are available in at least three ASEAN markets. It is interesting to note that the list considers variable CRS categories, directions, and interfaces for a comprehensive assessment.

One of the main concerns is the relevance of the reference list as the CRS market keeps expanding. Therefore, there is a crucial need to update the CRS reference list to ensure that the CRS used in ASEAN NCAP assessments remains relevant. Hence, this study aims to identify the most coincide CRS model that is currently available in the ASEAN countries market. Due to practical constraints, this paper focuses on four ASEAN countries including Malaysia, Indonesia, Thailand, and Vietnam, which represent the major portion of the ASEAN automotive markets.

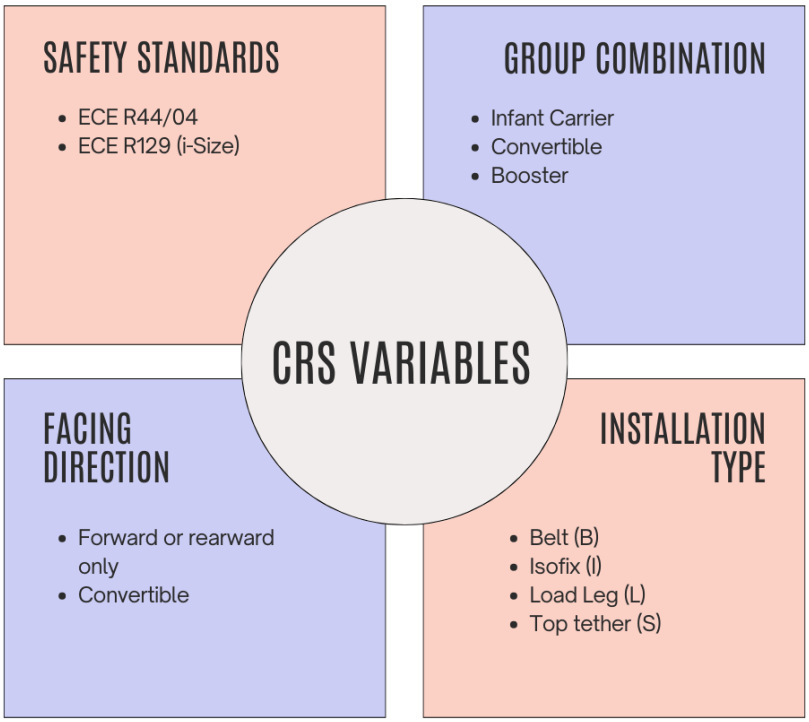

FIGURE 1: CRS variables offered in the current ASEAN market

TABLE 1: CRS reference list (ASEAN NCAP, 2019)

Category[a]	CRS Model	Facing Direction	Installation Type[b]
Group 0+	Peg-Perego Primo Viaggo SL	Rearward	B _ _ _
Group 0+/I/II	Joie Stages	Rearward	B _ _ _
Group 0+/I/II	Joie Stages	Forward	B _ _ _
Group II/III	Combi Buon Junior Air	Forward	B _ _ _
Group 0+	Maxi Cosi Cabriofix + Family Fix	Rearward	_ I L _
Group 0+/I	Joie Every Stage FX	Forward	_ I _ S
Group 0+/I	Joie Every Stage FX	Rearward	B _ _ _
Group I	Maxi Cosi Titan Pro	Forward	_ I _ S
Group II/III	Britax Kidfix 2 R	Forward	B I _ _

[a] Group 0+ refers to 0-13kg, Group I refers to 9-18kg, Group II refers to 15-25kg and Group III refers to 22-36kg
[b] B refers to belt, I refers to ISOFIX, L refers to load leg and S refers to top tether installation type

2. METHODOLOGY

Market research involved physical data collection and observations in stores selling CRS across these four countries, as well as online data collection conducted through prominent e-commerce platforms such as Lazada, Shopee, Amazon, Tokopedia, Alibaba, and others. Related information such as CRS category, model, group category, approved regulation, facing direction, and installation type were also recorded. The list of CRSs identified was tabulated in a database. The evaluation criteria for the CRS reference list revision are based on Table 2. Weightage was given accordingly to rank the importance of the pre-determined criteria. The overall process of establishing the updated CRS reference list is summarized in Figure 2.

The regulatory approval under the UNECE Regulation was identified as the most important criterion since the CRS conformance to the safety regulation is of the utmost concern. Therefore, for the revision of the list, the CRS selected must conform to ECE R44 (UN, 2020) or R129 (UN, 2021). As for Malaysia itself, the CRS Act was mandated in 2020, requiring products entering the country to be approved by the UNECE Regulation. It is crucial to stay updated with the most recent guidelines concerning child safety. The R129 standard has replaced the R44 standard, marking a significant change in the CRS industry. This change represents a turning point in child safety regulations, as R129 offers improved protection for our most valued passengers through design and technological innovations.

The second highest weightage was given to the availability of CRS in ASEAN countries. As mentioned before, the revision of the CRS reference list primarily focuses on four ASEAN member countries i.e. Malaysia, Indonesia, Thailand, and Vietnam. These countries were selected because they have the highest automotive markets in ASEAN (Abidin et al., 2022; STATISTA, 2023). The consideration of Malaysia, Indonesia, and Thailand was also based on their similarities in road safety scenarios and automotive economic growth, as suggested by Husain et al. (2018). Vietnam was included due to its emergence as a significant player in the region, particularly in recent years, as noted by Nakajima et al. (2023). However, this study requires CRS availability in at least three of the four mentioned countries to be considered for inclusion in the reference list.

Next, the rest of the related information was scrutinized to ensure the variability of the reference list. The group combination criteria are weighted as “3” and aim to ensure a variety of CRS options that can accommodate different child sizes and age groups. CRS facing direction is weighted as “2”, which determines the type of assessment under the ASEAN NCAP COP CRS installation section. Whereas CRS installation type is also included in the selection criteria and weighted as “1” to assess various vehicle installation types.

Meanwhile, the price of the CRS was not considered and therefore excluded from the criteria as it does not signify the importance of child safety and the effectiveness of the CRS in protecting children in vehicles. Instead, the selection criteria focus on factors such as design, compatibility, ease of installation, and adherence to safety standards. By prioritizing these aspects, the assessment aims to ensure that the CRS selected for evaluation offers optimal protection for children, regardless of their price point.

TABLE 2: Evaluation criteria and its weightage for the CRS reference list

Evaluation Criteria	Variables	Importance Weightage
Approved Regulation	R44 & R129	5
Availability in ASEAN Country	Malaysia, Indonesia, Thailand, Vietnam	4
Group Combination	Infant Carrier, Convertible, Booster	3
Facing Direction	Forward or rearward only, Convertible	2
Installation Type	Belt (B), Isofix (I), Load Leg (L), Top tether (S)	1

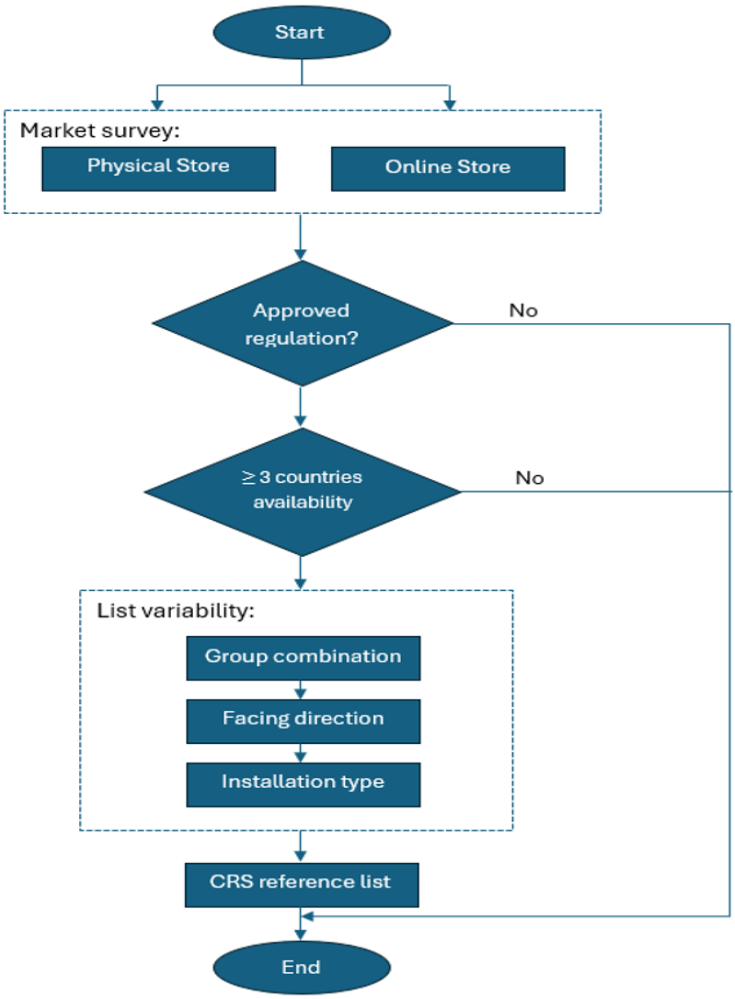

FIGURE 2: Process of establishing the CRS reference list in the ASEAN market

3. RESULTS AND DISCUSSION

Overall, there are in total 167 CRS models (R44 & R129) were identified as sold in either Malaysia, Indonesia, Thailand, or Vietnam. However, only 14.37% of the list falls within the specified evaluation criteria. The list of CRSs that meet the established selection criteria (refer to Table 2) is presented in Table 3.

Figure 3 represents the availability of R44 and R129 CRS in the four countries. Thailand showed the highest number of available CRS in the four countries (R44 40%, R129 34%). Vietnam showed the lowest availability of CRS in the market (R44 11%, R129 11%).

TABLE 3: CRS list in at least three countries

Type	Brand	Model	Market Readiness				R44	R129	Facing Direction	Installation Type
			Malaysia	Indonesia	Thailand	Vietnam				
Infant Carrier	Joie	Gemm					/		Rearward	IL, B
		i-Gemm 2						/	Rearward	IL, B
		i-Gemm 3						/	Rearward	IL, B
	Maxi Cosi	Cabriofix					/		Rearward	B
	Nuna	Pipa Next						/	Rearward	IL, B
Covertible	Joie	Every Stages					/		Forward, Rearward	B
		Every Stages Fx					/		Forward, Rearward	IS, B
		Spin 360					/		Forward, Rearward	IL
		Steadi					/		Forward, Rearward	B
		Stages					/		Forward, Rearward	B
		Stages Fx					/		Forward, Rearward	B
		i-spin Grow						/	Forward, Rearward	I
		i-Spin 360						/	Forward, Rearward	IL
		Every Stages (R129)						/	Forward, Rearward	B
		Steadi (R129)						/	Forward, Rearward	B
	Recaro	Salia						/	Forward, Rearward	IL
	Nuna	Todl Next						/	Forward, Rearward	IL
	Chicco	Seat 3 Fit i-size Air						/	Forward, Rearward	I
Booster	Joie	Trillo					/		Forward	B
		Elevate (R129)						/	Forward	B
		Elevate					/		Forward	B
		i-Chapp						/	Forward	B
	Recaro	Maco Elite 2						/	Forward	I, B
	Cozy N Safe	Augusta i-size						/	Forward	I, B

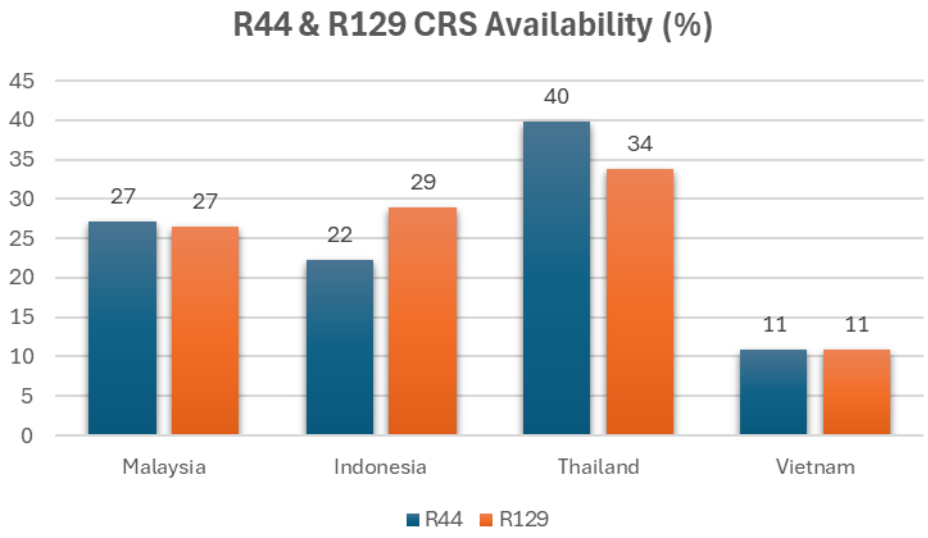

FIGURE 3: R44 and R129 CRS availability

Figure 4 represents the availability of CRS models. Based on the market survey, only 7% of the available CRS in the market are available in the four countries. 70% of the CRS models are only available in one country which is not qualified to be shortlisted. Figure 5 represents the installation type and group combination for the CRS identified.

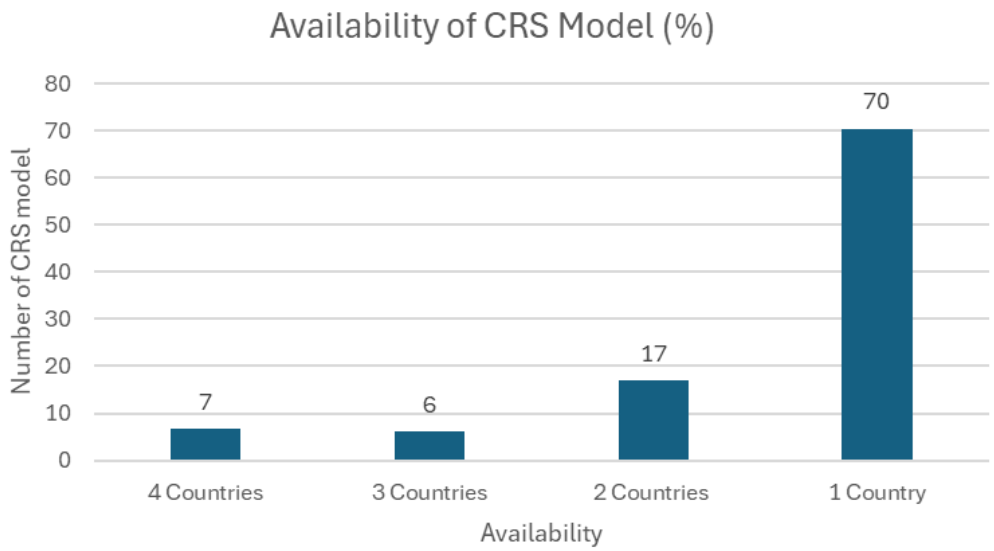

FIGURE 4: Availability of CRS model based on number of countries

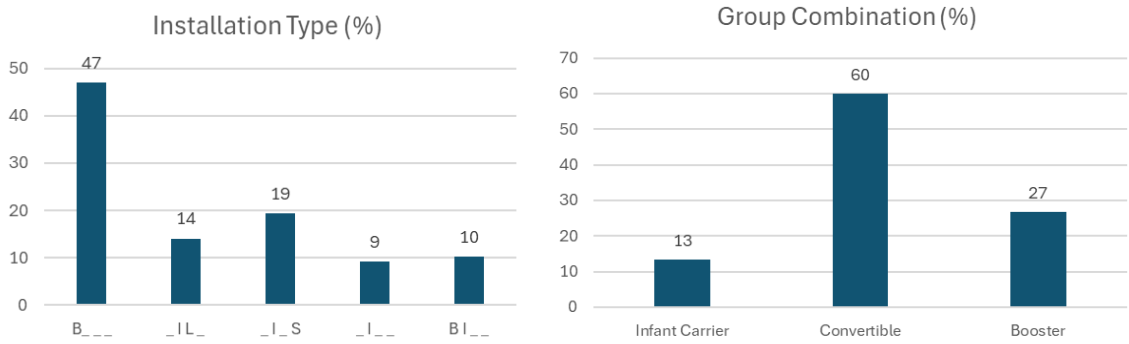

FIGURE 5: Availability based on installation type and group combination

There are 24 models eligible to be shortlisted to revise the ASEAN NCAP CRS reference list. It is observed that nearly 60% of the CRSs are approved under UN R129, the latest UNECE Regulation governing CRS conformity. Therefore, the selection process is further refined to focus exclusively on CRSs with UN R129 approval. 13 CRS models are the convertible type, whereby baby carrier and booster are 5 and 6, respectively. In terms of installation type, 75% of CRS can be installed with seat belts, Isofix constitutes 54%, 33% comes with a load leg and only 1 CRS needs a top tether for installation. The combination of installation modes is also recorded in Table 3. The final revised ASEAN NCAP CRS Reference List is shown in Table 4. Nine CRS models were finalized and will be used for the ASEAN NCAP 2026-2030 COP Assessment.

TABLE 4: Revised ASEAN NCAP CRS reference list

CRS Installation Assessment				
	Category	CRS	Direction	Interface
Reference List	<85cm	**Joie i-Gemm 3**	Rwd	B _ _ _
	<85cm	**Joie i-Gemm 3 + Joie i-base**	Rwd	_ I L _
	40-105 cm	**Joie Steadi**	Rwd	B _ _ _
	76-105 cm	**Joie Steadi**	Fwd	B _ _ _
	76-150 cm	**Joie Elevate**	Fwd	B _ _ _
	40-105 cm	**Nuna Todl Next + Nuna Base Next**	Rwd / Fwd	_ I L _
	40-105 cm	**Recaro Salia**	Rwd / Fwd	_ I L _
	40-105 cm	**Chicco Seat 3 Fit I-Size Air**	Rwd / Fwd	_ I L _
	40-125 cm	**Joie i-Spin Grow**	Rwd / Fwd	_ I _ S
	100-150 cm	**Cozy N Safe Augusta i-Size**	Fwd	B I _ _
	100-150 cm	**Recaro Maco Elite 2**	Fwd	B I _ _

4. CONCLUSION

In conclusion, the revised CRS reference list presents a meticulous selection of child restraint systems meeting ASEAN NCAP's stringent criteria. By prioritizing UN R129-approved CRS and considering factors such as compatibility, installation ease, and child protection effectiveness, this updated list offers valuable guidance to caregivers and policymakers in the ASEAN region. It underscores a commitment to enhancing child occupant protection and promoting safer travel for families. From another perspective, this study provided an important opportunity to advance the understanding of retrofitted automotive safety component dynamics in the market.

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