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Changes for Gamelan Pelegongan in Bali of Indonesia

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Abstract

The authors have studied the changes of Balinese Gamelan in Indonesia by acoustical analysis and interviews to Gamelan player, owners, makers and tuners are discussed and described. Approximately 100 sets of Gamelan, mainly Gamelan Gong Kebyar which is commonly used in Bali were measured and analyzed in Japan and Bali. As a result, for the 11 sets of Gamelan Gong Kebyar relating to educational institutions – KOKAR (Konservatori Karawitan Indonesia) and ASTI (Akademi Seni Tari Indonesia), the pitch of the lowest tone, pitch name '*ding*', in pentatonic scale was C# or D of western pitch. Especially, all sets newer than ASTI's had C#.

In this paper, 11 sets of Gamelan Pelegongan that is older than Gamelan Gong Kebyar were measured and their pitches calculated from frequency analysis of metallophones were compared and examined. Three sets of them were also Gamelan Semar Pegulingan. Gamelan Pelegongan has a 5-tone pelog scale same as Gamelan Gong Kebyar. As a result, the pitch of '*ding*' for the 10 sets of Gamelan Pelegongan was between C# to D#. For three sets of Gamelan Pelegongan with Trompong that are originally categorized as Gamelan Semar Pegulingan, it was D#. Seven sets of Gamelan Pelegongan with no Trompong, it was basically D or C#. In particular, it was C# for those made after 1930. Therefore, the pitch of '*ding*' of Gamelan Pelegongan made as Gamelan Semar Pegulingan to play instrumentals in those days was basically D#. As they began to be used to accompany dance such as Legong dance and Barong dance in the 20th Century, Gamelan Pelegongan tended to be made with a lower pitch.

Keywords: Bali of Indonesia, Soundscape, Gamelan Pelegongan, Pitch, Gender Rambat

1. Introduction

Bali in Indonesia is known as an island of gods and entertainment. For the Balinese people, Gamelan music is a part of living and is indispensable to the everyday soundscape. Therefore, understanding its acoustic structure and changes means to understand taste in sound of the Balinese people as well as its changes.

The ultimate purpose of this study is to clarify changes of Balinese Gamelan in Indonesia from the 18th to 21st Century with acoustic analysis of these instruments in Bali.

In the previous report[1], pitches in fundamental frequency were analyzed mainly by using Gamelan Gong Kebyar owned by the educational institution that influenced many Gamelan Gong Kebyars made in Bali in the late 20th Century, and it was confirmed as a result that the pitch name 1, the lowest pitch in the pentatonic scale, was tuned to C# or D.

In this report, Gamelan Pelegongan that has the same 5-tone pelog scale as Gamelan Gong Kebyar and is an older Gamelan

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than that was analyzed.

2. Gamelan Pelegongan

Gamelan Pelegongan has the same 5-tone pelog scale as Gamelan Gong Kebyar, while the number of keys for metallophones Pemade and Kantilan is five, i.e., different from Gamelan Gong Kebyar (10 keys). As mentioned in the previous report[1], the popularity of new Gamelan Gong Kebyar made in the early 20th Century was high and a considerable number of Gamelan Pelegongans were modified to make Gamelan Gong Kebyar, or their bronze part was melted to make new Gamelan Gong Kebyar. Therefore, there are very few Gamelan Pelegongans that existed since early times (some were newly made during the revival boom in the 1980s, although the number is small because musical pieces can be played with Gamelan Gong Kebyar).

Gamelan Pelegongan is a type of Gamelan basically used to accompany Legong dance and Barong dance. It is called Gamelan Bebarongan if it is used to accompany Barong dance only. Gamelan Pelegongan to play only instrumentals along with Trompong (the instrument consists of small gongs) to play a melody is called Gamelan Semar Pegulingan and is older than Gamelan Pelegongan, and many of them were transferred from the royal palace to the rural community in the 19th Century to the early 20th Century. Gamelan Semar Pegulingan has the same pelog scale with five or seven tones. Only two sets with seven tones made in the early 20th Century currently remain, and many others have five tones. The composition of instruments is basically the same as Gamelan Pelegongan except Trompong.

In this report, Gamelan Pelegongan, Gamelan Bebarongan, and Gamelan Semar Pegulingan with five tones used for Legong dance are all treated as Gamelan Pelegongan.

3. Instruments used for analysis

Bronze percussion instruments in Gamelan Pelegongan can be divided into metallophones and gongs as indicated in **Fig.1**. The target of analysis at this time includes the metallophones with a range of four octaves.

For Gamelan Pelegongan, and a pelog scale with one octave consists of five tones.

Gender Rambat is a metallophone with 13 to 15 bronze keys (the number of keys is different depending on villages for older instruments, but is normally 14 for those that were made recently) to play a melody with mallets in both hands (**Fig.2**). A full set of Gamelan Pelegongan includes two Gender Rambats and two one-octave high Gender Rambat Barangans.

They all have five bronze keys with one octave other than Gender Rambat. There are four types of metallophones : Jegogan with the lowest octave (**Fig.3**), Jublag with the second lowest octave (Fig.3), Pemade with the third lowest octave and Kantilan with the highest octave (Fig.2). One set of Gamelan Pelegongan has two each of Jegogan and Jublag that are tuned by slightly shifting the pitch of the corresponding five keys, creating interference beats. There are four instruments of both Pemade and Kantilan. Respectively, two of them create a pair and are tuned by

Fig.1 Gamelan Pelegongan for ISI

Fig.2 Gender Rambat, Pemade and Kantilan

Fig.3 Jegogan and Jublag

Fig.4 Jongkok

Scale	ding	dong	deng	dung	dang
Balinese Character	ᬳ	᬴	ᬲ	ᬵ	ᬭ
Numeral	1	2	3	5	6
	← low		Pitch		high →

Fig.5 Pitch name for Gamelan

slightly shifting the pitch of the corresponding five keys, creating interference beats. Pemade and Kantilan in the full set of Gamelan Pelegongan may have the cross-sectional surface of keys in a semicylindrical shape (the cross-sectional surface of keys is usually in a trapezoidal shape), called Jongkok (**Fig.4**). There are four of them, respectively. However, existing old Gamelan Pelegongan often includes four Pemades and four Kantilans where metallophones with keys in a trapezoidal shape and semicylindrical shape are mixed.

A key with a higher pitch (Pengisep) is made first, and then one with a lower pitch (Pengumbang) is adjusted and made by hearing the interference beats with the first key as the reference.

Therefore, the Pengisep key that becomes a reference is analyzed to compare the pitches of each set.

The 5-tone pelog scale of Gamelan used in Bali is indicated in **Fig.5**. The characters in the middle line are letter notations traditionally used in Bali and their pronunciation is indicated on the top by using alphabet. The numbers on the bottom are numerical notations used at a college of music, etc., indicating the pelog scale of Gamelan Pelegongan has five tones including the 1st, 2nd, 3rd, 5th and 6th of seven tones. The numerical notations in Fig.5 are used in this report.

4. Gamelan Pelegongan to be measured

There are 11 sets of Gamelan Pelegongan for measurement, and all of them are in the southern part of Bali. This seems to be because Legong dance and Barong dance originated in the southern part of Bali. Details are explained in the following.

4.1 Set A

Set A of Gamelan Pelegongan is owned by ISI (Institute Seni Indonesia Denpasar) in Bali (Fig.1). It was made around 1990 and is exhibited in the museum of the Institute. I Wayan Beratha who was a performer and a Gamelan maker at the same time made and tuned it. Gender Rambat has 14 keys. Measurement was conducted in 2013.

4.2 Set B

Set B of Gamelan Pelegongan is owned by Banjar (village) Blah Kiuh in Kabupaten (region) Gianyar. This instrument is Gamelan Bebarongan used to accompany Barong dance. The time of production is uncertain, but according to local performers, it seemed to have existed before 1950. Gender Rambat has 13 keys. Measurement was conducted in 2014.

4.3 Set C

Set C of Gamelan is owned by Banjar Abian Nangka Kaja in Denpasar. It was modified to Gamelan Gong Kebyar around 1946. Since there is a record of participation in the festival in Surabaya as Gamelan Pelegongan in 1936 and it was modified to Gamelan Gong Kebyar to match the pitch of Gender Rambat that existed in those days, it was measured as Gamelan Pelegongan. Rangda (witch) appears at the end of Legong dance accompanied by this Gamelan. Gender Rambat has 14 keys. Measurement was conducted in 2017.

4.4 Set D

Set D of Gamelan Pelegongan is owned by Banjar Meranggi in Denpasar. This instrument is used to accompany Legong dance similar to Set C. The time of production is uncertain; however it might have been made around 1935 because the Kumpur stand has the engraving of “1935” (**Fig.6**). Gender Rambat has 13 keys. Measurement was conducted in 2017.

Fig.6 Kempul stand for Meranggi

4.5 Set E

Set E of Gamelan Pelegongan is owned by Banjar Kelandis in Denpasar. The time or production is uncertain; however it seems to have been made in the early 1930s according to local people concerned. Gender Rambat has 13 keys. Measurement was conducted in 2017.

4.6 Set F

Set F of Gamelan Pelegongan is owned by Banjar Carik Tista in Kerambitan of Kabupaten Tabanan. The time of production is uncertain; however it might have been made around 1937 because the Gender Rambat stand has the engraving of "1937" (**Fig.7**). This set is called Andir in the region. Gender Rambat has 15 keys. Measurement was conducted in 2014.

4.7 Set G

Set G of Gamelan Pelegongan is owned by Banjar Tunjuk Kelod in Kabupaten Tabanan. According to Sumandhi, the leader of the Gamelan group 'Kusuma Sari' that plays this instrument, it seems to have existed at least around 1925. Legong dance accompanied by this Gamelan set is called Leko, the same name as female dance accompanied by bamboo-made Gamelan that was passed down in Kabupaten Tabanan since early times, and this set is also called Gong Leko (**Fig.8**). Gender Rambat has 15 keys. Measurement was conducted in 2008.

4.8 Set H

Set H of Gamelan Pelegongan is owned by Banjar Ketewel in Kabupaten Gianyar. It is currently stored in Pura (temple) Jogan Agung. Sanghyang Legong dance offered at Odalan (temple festival) using this instrument is believed to be the first dance called Legong[2].

Fig.7 Gender Rambat for Carik Tista

According to the monk at the temple, it was probably made in the 19th Century. There were originally two Gender Rambats since a certain time (probably from the end of 18th Century to the early 19th Century), and instruments increased gradually since then. This Gamelan set in Ketewel includes Trompong, and is currently categorized as Gamelan Semar Pegulingan with five tones.

As mentioned in the above, however, Trompong seems to have been made at a later time to be able to play instrumentals as well, considering that fact that there were originally two Gender Rambats and that Trompong is not played to accompany Sanghyang Legong dance. Gender Rambat has 13 keys (**Fig.9**). Measurement was conducted in 2014.

4.9 Set I

Set I of Gamelan Pelegongan (**Fig.10**) is owned by Banjar Teges Kanginan in Peliatan of Kabupaten Gianyar.

It is Gamelan Semar Pegulingan with five tones including Trompong that existed at the end of the 19th Century and was

Fig.8 Gong Leko

Fig.9 Gender Rambat for Ketewel

Fig.10 Gamelan Pelegongan of Teges Kanginan

originally owned by Puri (Royal Palace) Agung Peliatan[3]. Gender Rambat has 14 keys. Legong dance of Banjar Teges Kanginan was very famous at the end of the 20th Century, while it does not seem to be performed very often these days. Measurement was conducted in 2014.

4.10 Set J

Set J of Gamelan Pelegongan is owned by Banjar Bongan Jawa in Kabupaten Tabanan. According to the interview of local people, this Gamelan set was succeeded from Puri Agung Tabanan. It includes Trompong (**Fig.11**) but there is no Gender Rambat. While the time of production is uncertain, it seems to have existed prior to 1950 according to a monk in the temple. It looks like they always perform Legong dance by using this Gamelan at a temple affiliated to the Banjar. Measurement was conducted in 2014.

4.11 Set K

Set K of Gamelan Pelegongan is owned by Banjar Taman in Sanur of Denpasar. According to Merta, a member of the Gamelan group 'Taman Sari' that performs this instrument, Gamelan Pelegongan that existed from old times was modified to Gamelan Gong Kebyar by keeping only two Gender Rambats and melting the bronze part on keys, to be able to perform Drama Gong in 1970. Since these Gender Rambats were acquired at a high price in those days, advice by the elderly to "keep them without melting!" seems to have been observed. When the Gamelan Bebarongan boom returned in the 1980s, it seems to have been remade again to match these Gender Rambats.

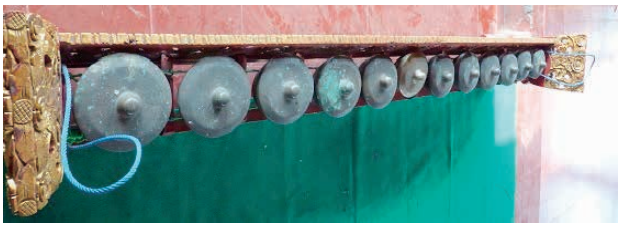

Fig.11 Trompong for Bongan Jawa

Fig.12 Gender Rambat for Taman

The analysis data of this Gamelan Pelegongan measured in the 1930s is also included in "Music in Bali" written by Colin McPhee[4].

This instrument is currently played to offer Barong dance at Odalan of Pura Dalem in Banjar Taman. Gender Rambat has 13 keys (**Fig.12**). Measurement was conducted in 2011.

5. Measurement method and analysis

DAT or Wave Recorder (sampling frequency 44.1 kHz or 48 kHz; quantization 16-bit) was used for recording. Since it was basically measurement of frequency only, keys of each instrument were hit one by one in the quiet surroundings and by paying attention to background noise and adjusting the level to prevent overloading. Digital data recorded was stored on a computer hard disk in the WAV file format, and frequency was analyzed with FFT software made by B&K to obtain the fundamental frequency of each key. Resolution performance

Table 1 Pitch of Gamelan Pelegongan for ISI

Pitch Name	Frequency (Hz)	Pitch (cent)
1-1	142.5	C#3 +48
1-2	154.0	D#3 −17
1-3	170.0	F3 −46
1-5	212.0	G#3 +36
1-6	227.5	A#3 −42
2-1	285.5	D4 −49
2-2	304.0	D#4 −40
2-3	329.0	E4 −3
2-5	425.0	G#4 +40
2-6	458.5	A#4 −29
3-1	565.0	C#5 +33
3-2	605.0	D#5 −49
3-3	655.5	E5 −10
3-5	822.0	G#5 −18
3-6	882.0	A5 +4
4-1	1144.5	D6 −45
4-2	1212.5	D#6 −45
4-3	1335.0	E6 +22
4-5	1681.5	G#6 +21
4-6	1833.0	A#6 −30

of frequency can be randomly set, while 0.5Hz was used at this time.

With the A4 pitch at 440 Hz, the frequency of each key, f Hz, is converted into the cent unit to indicate each pitch with equal temperament of 12 degrees in western music. The pitch of Gamelan Pelegongan owned by ISI is indicated in **Table 1** as an example. The interval has four octaves, and because of the pentatonic scale, the last pitch name in the first octave is indicated as 1-6. As explained in the above, the pitch is indicated with the pitch name in equal temperament of 12 degrees, and ± represents the cent difference. For example, the pitch of the pitch name 1-1 is C#3; however is 48 cents higher. The pitch of each pentatonic scale for four octaves is eventually averaged for comparison purposes. The error range of final analysis results with frequency resolution capability of 0.5Hz was within ±2 cents, i.e., there is no significant influence.

6. Measurement results and discussion

Pitches of Gamelan Pelegongan from Sets A to K are indicated in **Table 2**. The data on Gamelan Gong Kebyar made by Beratha in 1969 and owned by ISI is indicated as Set L for reference.

When Set A of Gamelan Pelegongan owned by ISI is compared with Set L of Gamelan Gong Kebyar (both of them were made by Beratha), pitches of the former are arranged in the order of C#, D#, E, G#, and A# from the lowest pitch, and that of the pitch name 5 is 40-cent higher compared with the latter; however the five tones for both are almost equal with no significant difference. Based on the above, it is likely that Gamelan Pelegongan was made around 1990 in reference to Gamelan Gong Kebyar with the same pelog scale made in 1969. Since the pitch of the pitch name 5 of Gamelan Gong Kebyar made around 1990 tends to be tuned higher than that of ISI[1)], that of the pitch name 5 of Set A of Gamelan Pelegongan was probably tuned 40-cent higher than Set L in the same way.

For Sets H, I, and J with Trompong that are originally categorized as Gamelan Semar Pegulingan, the pitch of the pitch name 1, the lowest pitch in five keys, is D#. For other Gamelan Pelegongans with no Trompong, that of the pitch name 1 is basically D or C# except Set K. In particular, it is C# for those made after 1930. Therefore, the pitch of the pitch name 1 of Gamelan Pelegongan made as Gamelan Semar Pegulingan to play instrumentals in those days was basically D#. As they began to be used to accompany dance such as Legong dance and Barong dance in the 20th Century, Gamelan Pelegongan tended to be made with a lower pitch. Various reasons can be considered, e.g., the pitch goes lower as the sound of music that accompanies energetic and strong Barong dance is louder and their instruments need to be made largely and solidly, D# for the pitch name 1 is too high and difficult to sing when lyrics are added to dance accompaniment, etc., while it is difficult to judge unconditionally. Measurement data is to be increased for further consideration in the future.

Regarding Set K of Gamelan Pelegongan in Banjar Taman

Table 2 The Pitches for the 11 sets of Gamelan Pelegongan and one set of Gamelan Gong Kebyar[*1)]

Set	Owner	YEAR	1 (cent)	2 (cent)	3 (cent)	5 (cent)	6 (cent)
A	ISI	ca. 1990	C# +47	D# −38	E +16	G# +20	A# −49
B	Blah Kiuh	pre.1950	C# −34	D +12	E −18	G +46	A −37
C	Abian Nangka Kaja	pre.1936	C# −1	D +45	E −3	G# −15	A −3
D	Meranggi	ca. 1935	C# −45	D −15	E♭ +33	G +19	A♭ +20
E	Klandis	early 1930s	C# +47	D# −21	F −19	G# +30	A +37
F	Carik Tista	ca.1937	C# +45	D# −31	F −40	G# −5	A +31
G	Tunjuk (Leko)	pre.1925	D +34	E♭ +42	F +0	A −21	B♭ +8
H	Ketewel	18-19th cent.	D# +18	F# +5	G# −34	C −41	C# +15
I	Teges Kanginan	19th cent.	D# +14	F −9	G♭ −9	A# −24	B +10
J	Bongan Jawa	pre.1950	D# +1	E +37	F# +2	A# −40	B −4
K	Taman	pre.1930s	F −9	G♭ +41	A♭ −26	C +3	D♭ +27
L	ISI (Gong Kebyar)	1969	C# +43	D# −30	E +26	G# −20	A +12

*1) Some data are different from those in literature 5) as all of data had been reanalyzed and recalculated.

in Sanur, the pitch of the pitch name 1 is F, i.e., very high compared with other 10 sets. According to Merta, a member of Taman Sari, there are two more sets of old Gamelan Pelegongan in Sanur with approximately the same pitch as the Gamelan Gong Kebyar owned by Taman Sari, i.e., that of the pitch name 1 is C#. This is also suggesting that Set K of Gamelan Pelegongan has an exceptionally high tone.

7. Conclusion

Pitches in 11 sets of Gamelan Pelegongan that have the same 5-tone pelog scale as Gamelan Gong Kebyar and is older than that were examined at this time.

It was confirmed as a result that the pitch name 1, the lowest pitch in the pentatonic scale, was almost tuned between C# and D#, and there was a tendency that the pitch for the pitch name 1 goes down from D# to C# with the times. Looking at the pitches in the pentatonic scale for these 11 sets of Gamelan Pelegongan, some of them have a semitone or more difference between the pitch names 3and 6 even though the pitch for the pitch name 1 is the same. Therefore, it is necessary to examine not only pitches but also intervals. It is our hope to also analyze Gamelan Semar Pegulingan with the same pelog scale which is believed to be older than Gamelan Pelegongan to research transition of pitches and intervals of Gamelan by area and age in the future.

Notes

Analysis results of eight sets of Gamelan Pelegongan conducted in the literature 5) along with an additional three sets were reexamined in this paper.

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Owners of Gamelan Pelegongan and Gamelan Gong Kebyar analyzed in this paper included ISI, Banjar Abian Nangka Kaja, Meranggi and Kelandis in Denpasar, Banjar Taman in Sanur village, Denpasar, Banjar Carik Tista, Tunjuk Kelod and Bongan Jawa in Tabanan region, in Banjar Blah Kiuh, Ketewel and Teges Kanginan in Gianyar region and I Nyoman Sumandhi and I Wayan Merta assisted us for some local measurements. We express our deep gratitude to all of them.

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インドネシア・バリ島におけるガムラン・プレゴンガンの変遷

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概　要

バリ島で一般的に使われているガムラン・ゴング・クビャールを中心に，日本とバリ島で，約 100 セットのガムランの測定解析を行ってきた。その結果，バリ島の教育機関 SMKI と ASTI と関わりのあるガムラン・ゴング・クビャール 11 セットの音名 ‘ding’ の音高は C# か D であり，特に ASTI より新しいそれらは，いずれも C# であることが明らかにされた。本報では，ガムラン・ゴング・クビャールよりも古く，レゴンダンスあるいはバロンダンスの伴奏のために使われるガムラン・プレゴンガン 11 セットの鍵盤楽器における基本周波数の音高を分析し，比較検討している。11 セット中 3 セットは，トロンポンがあるガムラン・スマルプグリンガンでもある。ガムラン・プレゴンガンは，ガムラン・ゴング・クビャールと同様，ペロッグ音階を持っている。これらを分析した結果，10 セットの音名 ‘ding’ における音高は，いずれも C# から D# の間であることが明らかにされた。ガムラン・スマルプグリンガンに分類されるトロンポンがあるガムラン・プレゴンガン 3 セットのそれは，いずれも D# である。トロンポンがないガムラン・プレゴンガン 7 セットのそれは，D か C# である。特に，1930 年以降に製作されたもののそれはすべて C# である。これらから，当初，器楽演奏用のガムラン・スマルプグリンガンとして製作されたガムラン・プレゴンガンの音名 ‘ding’ は，基本的に D# で製作されて，20 世紀に入り，レゴンダンスやバロンダンスなどの踊りの伴奏に使われるようになるにしたがって，ガムラン・プレゴンガンは音高を下げて製作されるようになっていったという傾向がみられる。

Biographical Sketches of the Authors

Shiokawa Hiroyoshi was born in March 31, 1961 in Kanagawa Prefecture, Japan. He obtained his Bachelor's Degree of Engineering in 1983, his Master's Degree of Engineering in 1985 and his Doctoral Degree of Engineering in 1994 from Nihon University. Dr Shiokawa is a professor of department of Architecture and Architectural Engineering, College of Industrial Technology, Nihon University. He is a member of The Acoustical Society of Japan (ASJ), The Society for Research in Asiatic Music (Tôyô Ongaku Gakkai, TOG), and Soundscape Association of Japan (SAJ) and the Architectural Institute of Japan (AIJ).

Umeda Hideharu was born in April 8, 1962 in Tokyo. He obtained his Bachelor's Degree of Musicology in 1986 from Kunitachi Collage of Music and his Master's Degree of International Studies in 1994 from J. F. Oberlin University. Mr. Umeda is a professor of department of Art Managements, Faculty of Cultural Policy and Management, Shizuoka University of Art and Culture. He is a member of The Musicological Society of Japan, The Society for Research in Asiatic Music and The Anthropological Society of Nipoon.

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Suzuki Yoshie was born in August 18, 1976 in Hokkaido Prefecture, Japan. She obtained her Bachelor's Degree of Music in 2001 from Kunitachi College of Music and her Master's Degree of Arts in 2005 and her Doctoral Degree of Arts in 2015 from Okinawa Prefectural University of Arts. She is a part-time lecturer of department of Music, Toho College of Music. She is a member of the Society for Research in Asiatic Music (Toyo Ongaku Gakkai).

I Made Kartawan was born in October 10, 1972 in Bali, Indonesia. He obtained his Bachelor's Degree of Music in 1983, his Master's Degree of Culture Studies in 2003 and Master's Degree of Ethnomusicology in 2014. Mr. Kartawan is a lecturer of Music Department of Performing Arts Faculty of Institute of Arts in Denpasar. He is a musician, a composer and a Balinese gamelan tuner. He has tuned several gamelans in Japan, USA, Canada, and Denmark. In 2010, he received a scholarship to study piano tuning at Kunitachi Music Academy, Tokyo Japan.