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Characteristics of Motorcycle Crashes of Food Delivery Workers

Jong Han Byun[1], Byung Yong Jeong[2], Myoung Hwan Park[2]

[1]Korea Occupational Safety & Health Agency, Training Institute, Ulsan, 44429
[2]Department of Industrial and Management Engineering, Hansung University, Seoul, 02876

Corresponding Author
Myoung Hwan Park
Department of Industrial and Management Engineering, Hansung University, Seoul, 02876
Mobile : +82-10-9027-1576
Email : mhpark@hansung.ac.kr

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Objective: This study aims to understand the motorcycle accident characteristics of food delivery workers and to present basic guidelines on accident prevention through accident.

Background: It is known that food delivery workers have a high ratio of self-employed and youth workers, and occupations with frequent disasters. Therefore the occupation is known to really be in need of accident prevention policy.

Method: This study analyzed the data of motorcycle crashes of 1,310 food delivery workers that have been approved as on-duty industrial crashes since 2015. The accident characteristics were examined by dividing them into driver related factors and accident related factors.

Results: Among the motorcycle crashes of food delivery workers, 99.2% of the victims were males, 82.6% had less than six months of work experience. 76.2% of the victims were employed by the companies with less than five workers. In addition, there was a difference in accident characteristics according to age, type of cuisine, accident time of the day, injured organs and injured body part.

Conclusion: The results of this study can be used as baseline data to devise systematic measures to prevent motorcycle crashes of food delivery workers.

Application: Preventative measures for novice young part time workers including safety education/training need to be established.

Keywords: Motorcycle crash, Work-related injury, Food delivery service, Industrial accident

1. Introduction

A goods delivery worker means a person transporting various goods that customers ordered or bought to customers-desired places. The Korean Standard Classification of Occupations (Statistics Korea, 2007) classifies goods delivery workers as mail delivery workers, door-to-door delivery workers, food delivery workers, and other delivery workers (Kim et al., 2016). Food delivery means an act delivering foods from diverse restaurants including Korean food, Chinese food, pizza, chicken, and fast food, according to customer's order.

Because a food delivery worker needs to deliver food before it cools off, he/she delivers food in a hurry for quick delivery. Especially, on holidays like Christmas Day or on rainy or snowy days, the risk of accident increases due to increase in orders. Food delivery is classified into delivery by person and by vehicle, and motorcycles are mainly used for food delivery by vehicle.

Food delivery using a motorcycle is a unique business model that Korean restaurant has, and it is usually done by part time student workers or the owner himself/herself when if the restaurant is small. Although most restaurants operate 24-hour delivery system, the food delivery workers is generally paid on hourly basis without nighttime extra-payment or incentives. Since a person aged 16 or older can acquire motorcycle driver's license under 125cc, food delivery is known to be a representative job with high ratio of youth workers. The employment type is day worker or part time worker, and the job includes nighttime or daybreak work. Also, workload is concentrated on specific time of day, and therefore the workers are pressed for time, which induces unsafe behaviors that result in crashes. Hence, the food delivery worker is regarded as an occupation with very high ratio of crashes, and especially with high ratio of motorcycle crashes, and also with high ratio of death crashes (Allen et al., 2017; Lin and Kraus, 2009; Manan and Varhelyi, 2012).

Motorcycle crashes are also known to be related to driver's age (Lin et al., 2003; Mullin et al., 2000), helmet wearing (Houston and Richardson, 2008), alcohol and other drug use (Williams, 2006), inexperience and driver training (Mullin et al., 2000; Lin et al., 2003; Woratanarat et al., 2013), and riding speed (Li et al., 2009). This study offers baseline data on accident prevention, as well as understanding of the accident characteristics of food delivery workers by analyzing the motorcycle accident characteristics of food delivery workers with high ratios of self-employed and youth workers and high ratio of traffic crashes.

2. Methods

Since this study targeted accidents acknowledged as on-duty industrial accidents occurring during food delivery using a motorcycle, any traffic crashes due to drinking alcohol or drug are not included in the analysis.

The data of the motorcycle crashes of 1310 food delivery workers, approved as on-duty industrial accidents since 2015, were analyzed in this study. The 1310 cases consisted of 29 deaths (2.2%), 153 disabled people (11.7%), and 1128 injured people (86.1%).

The motorcycle accident characteristics were analyzed using industrial accident investigation reports. The accident characteristics were examined by dividing the motorcycle crashes into driver related factors and accident related factors. Age, gender, work experience, size of employment and employment type were driver related factors, while cuisine type, time of day, day of week, body part injured, and injury type were accident related factors. This study analyzed the difference of accident distribution using a chi-square test according to accident characteristics and injury level. To test the difference of mean sick leave days of the injured and the disabled, one-way ANOVA was carried out. This study used SPSS, a statistical package, for statistical test, and significance level of 0.05 was applied.

3. Results

3.1 Analysis of the crashes in view of driver related factors

3.1.1 Analysis of the injured by age

Table 1 shows the distribution of the fatal and nonfatal injured and the characteristics of sick leave days. The proportion of the injured was 46.9% in their 30s or older, 30.8% in their 20s and 22.4% in their teens.

The distribution of the dead, the injured, and the disabled by age showed statistically significant differences (χ^2=16.504, p=0.002). Concerning injury level by age, the proportion of the dead was high in their teens (24.1%) and 20s (41.4%), but the proportion of the disabled was high in their 30s or older (60.1%).

Table 1. Distribution of the injured and mean sick leave days by age (years)

Age group	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
10s	7	19	267	293	410.0	96.5
	24.1%	12.4%	23.7%	22.4%	(383.5)	(104.1)
20s	12	42	349	403	559.4	103.5
	41.4%	27.5%	30.9%	30.8%	(902.8)	(82.1)
over30	10	92	512	614	344.5	119.61
	34.5%	60.1%	45.4%	46.9%	(253.4)	(91.2)
Total	29	153	1128	1310	411.66	109.17
	100%	100%	100%	100%	(533.3)	(92.2)
Statistical test	χ^2=16.504, p=0.002				F=2.384 p=0.096	F=6.499 p=0.002

As a result of a statistical test using one-way ANOVA, there is difference in the mean sick leave days by age for the injured (p=0.002). The mean sick leave days of the injured were in the order as follows:: 30s or older (119.61 days), 20s (103.53 days), and teens (96.53 days). It seems that the mean sick leave days gets longer as workers get older.

3.1.2 Analysis of the injured by gender

Table 2 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by gender. Males were 1299 (99.2%)

Table 2. Distribution of the injured and mean sick leave days by gender

Gender	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Male	29	150	1120	1299	414.4	108.8
	(100.0%)	(98.0%)	(99.3%)	(99.2%)	(538.3)	(92.1)
Female	0	3	8	11	270.0	156.1
	(0)	(2.0%)	(0.7%)	(0.8%)	(21.6)	(99.1)
Total	29	153	1128	1310	411.6	109.1
	(100%)	(100%)	(100%)	(100%)	(533.3)	(92.2)
Statistical test	χ^2=2.786, p=0.248				F=0.215 p=0.644	F=2.088 p=0.149

and females were 11 (0.8%) of the total injured. As a result of a statistical test on difference in the mean sick leave days by gender using one-way ANOVA, there was no difference (p> 0.05).

3.1.3 Analysis of the injured by work experience

Table 3 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by work experience. The proportion of the injured was 34.5% (452) in their 3~6 months of work experience, 24.8% (325) in their 1~2 months of work experience, and 23.3% (305) in their 2~3 months of work experience. That is, 92.1% of the injured experienced less than 6 months in work experience.

There is no statistically significant difference in the distribution of the dead, the injured and the disabled by work experience (χ^2=9.004, p=0.342).

According to the statistical test using one-way ANOVA on the difference in the mean sick leave days by work experience, there is no significant difference for the injured and the disabled (p> 0.05).

Table 3. Distribution of the injured and mean sick leave days by work experience (months)

Work experience	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Under 1	1	24	100	125	317.3	120.3
	(3.4%)	(15.7%)	(8.9%)	(9.5%)	(166.9)	(86.5)
1~2	6	39	280	325	375.9	112.6
	(20.7%)	(25.5%)	(24.8%)	(24.8%)	(349.4)	(92.6)
2~3	5	39	261	305	352.9	105.9
	(17.2%)	(25.5%)	(23.1%)	(23.3%)	(194.9)	(80.6)
3~6	15	33	404	452	642.9	104.2
	(51.7%)	(21.6%)	(35.8%)	(34.5%)	(1029.1)	(100.6)
Over 6	2	18	83	103	318.1	118.3
	(6.9%)	(11.8%)	(7.4%)	(7.9%)	(134.6)	(88.4)
Total	29	153	1128	1310	411.6	109.1
	(100%)	(100%)	(100%)	(100%)	(533.3)	(92.2)
Statistical test	χ^2=9.004, p=0.342				F=1.594 p=0.179	F=0.220 p=0.928

3.1.4 Analysis of the injured by size of employment

Table 4 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by size of employment. The proportion of the injured was 76.2% (998) for the company with less than 5 workers, 14.7% (193) for the company with 5~15 workers, and

9.1% (119) for the company with 16 or more workers.

There is no statistically significant difference in the distribution of the dead, the injured, and the disabled by size of employment ($\chi^2=4.893$, $p=0.298$).

According to the statistical test using one-way ANOVA on the difference in the mean sick leave days by size of employment, there is no significant difference for the injured and the disabled ($p>0.05$).

Table 4. Distribution of the injured and mean sick leave days by size of employment (persons)

Size of employment	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Under 5	25	109	864	998	408.8	109.1
	(86.2%)	(71.2%)	(76.6%)	(76.2%)	(592.6)	(95.2)
5 ~15	2	30	161	193	450.7	101.4
	(6.9%)	(19.6%)	(14.3%)	(14.7%)	(401.0)	(79.4)
Over 15	2	14	103	119	349.5	121.8
	(6.9%)	(9.2%)	(9.1%)	(9.1%)	(204.6)	(84.7)
Total	29	153	1128	1310	411.6	109.1
	(100%)	(100%)	(100%)	(100%)	(533.3)	(92.2)
Statistical test	$\chi^2=4.893$, $p=0.298$				$F=0.175$ $p=0.840$	$F=1.546$ $p=0.214$

3.1.5 Analysis of the injured by employment type

Table 5 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by employment type. The proportion of the injured was 67.3% (881) in their temporary position and 32.7% (429) in their regular position. There is no statistically significant difference in the distribution of the dead, the injured, and the disabled by employment type ($\chi^2=2.174$, $p=0.337$).

According to the statistical test using one-way ANOVA on the difference in the mean sick leave days by employment type, there is no significant difference for the injured and the disabled ($p>0.05$).

Table 5. Distribution of the injured and mean sick leave days by employment type

Position	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Regular	10	58	361	429	445.4	113.6
	34.5%	37.9%	32.0%	32.7%	(730.3)	(90.8)

Table 5. Distribution of the injured and mean sick leave days by employment type (Continued)

Position	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Temporary	19	95	767	881	391.0	107.0
	65.5%	62.1%	68.0%	67.3%	(368.0)	(92.9)
Total	29	153	1128	1310	411.6	109.1
	100.0%	100.0%	100.0%	100.0%	(533.3)	(92.2)
Statistical test	χ^2=2.174, p=0.337				F=0.374 p=0.542	F=1.264 p=0.261

3.2 Analysis of the crashes in view of accident related factors

3.2.1 Analysis of the injured by type of cuisine

Table 6 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by type of cuisine, where cuisine type was classified into Korean food, Chinese food, Western food, chicken, and snack. The proportion of the injured was 34.5% (452) in chicken delivery, 24.8% (325) in Chinese food delivery, and 23.3% (305) in 32.7% (429) in Western food delivery, respectively.

Table 6. Distribution of the injured and mean sick leave days by type of cuisine

Cuisine	Distribution of the injured (%)					Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	% in column	Disabled	Injured
Korean	1	24	100	125	(9.5%)	317.3	120.3
	(0.8%)	(19.2%)	(80.0%)	(100%)		(166.9)	(86.5)
Chinese	6	39	280	325	(24.8%)	375.9	112.6
	(1.8%)	(12.0%)	(86.2%)	(100%)		(349.4)	(92.6)
Western	5	39	261	305	(23.3%)	352.9	105.9
	(1.6%)	(12.8%)	(85.6%)	(100%)		(194.9)	(80.6)
Chicken	15	33	404	452	(34.5%)	642.9	104.2
	(3.3%)	(7.3%)	(89.4%)	(100%)		(1029.1)	(100.6)
Snack	2	18	83	103	(7.9%)	318.1	118.3
	(1.9%)	(17.5%)	(80.6%)	(100%)		(134.6)	(88.4)
Total	29	153	1128	1310	(100%)	411.6	109.1
	(2.2%)	(11.7%)	(86.1%)	(100%)		(533.3)	(92.27)
Statistical test	χ^2=22.572, p=0.004					F=2.098 p=0.084	F=1.039 p=0.386

The distribution of the dead, the injured, and the disabled by type of cuisine showed statistically significant differences (χ^2= 22.572, p=0.004). The proportion of the dead was high (3.3%), but the ratio of the disabled was low (7.3%) in chicken delivery while the proportion of the disabled was high in Korean food and snack delivery.

According to the statistical test using one-way ANOVA on the difference in the mean sick leave days by type of cuisine, there is no significant difference for the injured and the disabled (p>0.05).

3.2.2. Analysis of the injured by day of the week

Table 7 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by accident day of the week. The proportion of the injured was 19.3% (253) on Saturdays, 17.4% (228) on Sundays, and 15.4% (202) on Fridays. There is no statistically significant difference in the distribution of the dead, the injured, and the disabled by day of the week (χ^2=5.567, p=0.936).

According to the statistical test using one-way ANOVA on the difference in the mean sick leave days by day of the week, there is no significant difference for the injured and the disabled (p>0.05).

Table 7. Distribution of the injured and mean sick leave days by day of the week

Day of the week	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Mon	3	16	128	147	320.3	101.5
	(10.3%)	(10.5%)	(11.3%)	(11.2%)	(178.8)	(87.9)
Tue	4	22	135	161	418.5	108.5
	(13.8%)	(14.4%)	(12.0%)	(12.3%)	(346.2)	(92.5)
Wed	1	18	137	156	523.7	125.8
	(3.4%)	(11.8%)	(12.1%)	(11.9%)	(1275.1)	(113.9)
Thu	2	22	139	163	444.0	104.5
	(6.9%)	(14.4%)	(12.3%)	(12.4%)	(466.2)	(71.3)
Fri	5	24	173	202	377.5	111.2
	(17.2%)	(15.7%)	(15.3%)	(15.4%)	(330.0)	(85.9)
Sat	7	28	218	253	408.3	105.1
	(24.1%)	(18.3%)	(19.3%)	(19.3%)	(337.5)	(95.5)
Sun	7	23	198	228	389.4	108.8
	(24.1%)	(15.0%)	(17.6%)	(17.4%)	(303.9)	(92.5)
Total	29	153	1128	1310	411.6	109.1
	(100%)	(100%)	(100%)	(100%)	(533.3)	(92.2)
Statistical test	χ^2=5.567, p=0.936				F=0.240 p=0.962	F=1.032 p=0.403

3.2.3 Analysis of the injured by time of day

Table 8 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by daytime and nighttime. Daytime was defined from 06:00 to 18:00, and the nighttime was defined from 18:00 to 06:00. The proportion of the injured was 60.8% (796) during daytime and 39.2% (514) during nighttime, respectively. There is no statistically significant difference in the distribution of the dead, the injured, and the disabled by accident time of day ($\chi^2=3.957$, $p=0.138$).

According to the statistical test using one-way ANOVA on the difference in the mean sick leave days by time of day, there is no significant difference for the injured and the disabled ($p>0.05$).

Table 8. Distribution of the injured and mean sick leave days by time of day

Time of day	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Day	14	50	450	514	446.4	111.5
	(48.3%)	(32.7%)	(39.9%)	(39.2%)	(790.6)	(97.3)
Night	15	103	678	796	394.8	107.5
	(51.7%)	(67.3%)	(60.1%)	(60.8%)	(350.4)	(88.7)
Total	29	153	1128	1310	411.6	109.1
	(100%)	(100%)	(100%)	(100%)	(533.3)	(92.2)
Statistical test	$\chi^2=3.957$, $p=0.138$				$F=0.314$ $p=0.576$	$F=0.512$ $p=0.474$

3.2.4 Analysis of the injured by injured body organ

Table 9 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by injured body organ. The injured body organs for the injured took up in the following order: 1078 victims (77.7%) in the musculoskeletal system, 152 victims (11.6%) in the cerebral cardiovascular system, and 123 victims (9.4%) in the skin system.

The distribution of the dead, the injured, and the disabled by injured body organ showed statistically significant differences ($\chi^2=180.362$, $p<0.001$). The proportion of the cerebral cardiovascular system was high for the dead (75.9%), while the proportions the musculoskeletal system were high for the disabled (92.8%) and the injured (77.5%).

Table 9. Distribution of the injured and mean sick leave days by the injured body organs

Organ	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Musculoskeletal	2	142	874	1018	401.1	110.7
	(6.9%)	(92.8%)	(77.5%)	(77.7%)	(514.7)	(86.4)

Table 9. Distribution of the injured and mean sick leave days by the injured body organs (Continued)

Organ	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Cerebral cardiovascular	22	6	124	152	632.1	137.6
	(75.9%)	(3.9%)	(11.0%)	(11.6%)	(873.4)	(132.1)
Skin	1	4	118	123	490.0	58.8
	(3.4%)	(2.6%)	(10.5%)	(9.4%)	(756.8)	(55.0)
Others	4	1	12	17	274.0	194.5
	(13.8%)	(0.7%)	(1.1%)	(1.3%)	.	(86.7)
Total	29	153	1128	1310	411.6	109.1
	(100%)	(100%)	(100%)	(100%)	(533.3)	(92.2)
Statistical test	$\chi^2=180.362$, $p=0.000$				$F=0.406$ $p=0.749$	$F=20.134$ $p=0.000$

As a result of a statistical test using one-way ANOVA, there is difference in the mean sick leave days by the injured body organs for the injured ($p<0.001$). The mean of sick leave days for the cerebral cardiovascular system was 137.6 days, followed by the musculoskeletal system (110.7 days) for the injured.

3.2.5 Analysis of the injured by injured body part

Table 10 shows the distribution of the fatal and nonfatal injured and the mean sick leave days by injured body part. The proportion of the injured was 37.2% (487) for foot/leg, 15.6% (205) for face/head, 13.5% (177) for shoulder, and 12.1% (159) for hand/arm, respectively.

The distribution of the dead, the injured, and the disabled by injured body part showed statistically significant differences ($\chi^2=158.018$, p<0.001). The proportion of the face/head was high for the dead (75.9%), while the proportions the foot/leg were high for the disabled and the injured.

As a result of a statistical test using one-way ANOVA, there is difference in the mean sick leave days by the injured body part for the injured ($p<0.001$). The mean sick leave days by injured body part were revealed in the following order: femur/hip (151.6 days), shoulder (123.1 days), and facial/head region (117.9 days) for the injured.

Table 10. Distribution of the injured and mean sick leave days by the injured body part

Body part	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Foot/Leg	0	405	82	487	375.7	108.4
	0.0%	35.9%	53.6%	37.2%	(288.0)	(87.1)

Table 10. Distribution of the injured and mean sick leave days by the injured body part (Continued)

Body part	Distribution of the injured (%)				Mean sick leave days (s,d,)	
	Deaths	Disabled	Injured	Total	Disabled	Injured
Face/Head	22	175	8	205	543.3	117.9
	75.9%	15.5%	5.2%	15.6%	(763.4)	(122.0)
Shoulder	0	158	19	177	308.4	123.1
	0.0%	14.0%	12.4%	13.5%	(90.7)	(63.5)
Arm/Hand	0	139	20	159	343.5	97.9
	0.0%	12.3%	13.1%	12.1%	(345.5)	(68.0)
Neck	2	107	2	111	254.0	86.6
	6.9%	9.5%	1.3%	8.5%	(28.2)	(113.5)
Trunk	2	83	5	90	587.6	96.8
	6.9%	7.4%	3.3%	6.9%	(601.6)	(68.3)
Femur / Hip	0	48	17	65	685.1	151.6
	0.0%	4.3%	11.1%	5.0%	(1288.4)	(115.3)
Others	3	13	0	16	-	69.6
	10.3%	1.2%	0.0%	1.2%	-	(65.9)
Total	29	1128	153	1310	411.6	109.1
	100.0%	100.0%	100.0%	100.0%	(533.3)	(92.2)
Statistical test	$\chi^2=158.018$, $p=0.000$				$F=1.189$ $p=0.315$	$F=4.030$ $p=0.000$

4. Conclusion and Discussion

This study analyzed accident characteristics using the motorcycle accident data of food delivery workers in 2015. The study results show that differences in injury level exist by age, type of cuisine, accident time of day, injured body organ, and injured body part. The findings show that 99.2% of the victims were males, and many crashes occurred on Saturdays and Sundays when orders rush. 60.8% of total crashes took place at nighttime, between 18:00 and 06:00, than the daytime. As for the injured body organs, the musculoskeletal system showed the most at 77.7%, followed by the cerebral cardiovascular system at 11.6%. 75.9% of the dead were caused due to injuries in the cerebral cardiovascular system.

Concerning the company size, less than five workers took up 76.2% of the crashes. This is because systematic safety and health management was not conducted in the small size companies which lack appropriate on-duty accident prevention. In this regard, it is concluded that carrying out intensive accident prevention activities in the companies with less than five workers is necessary for accident reduction.

Additionally, temporary workers took up 67.3% of the fatal and nonfatal injured, and workers with less than 6 months of work experience took up 92.1%. This implies that most of the food delivery workers are engaged in food delivery without proper motorcycle operation training. Therefore, preliminary motorcycle safety education/training is institutionally required for novice food delivery workers who are either self-employed or young part timer.

Because young part time workers who lack confidence and experience took up most of food delivery workers, they tend to be exposed to crashes. British BSC's "Speak Up, Stay Safe" campaign (British Safety Council, 2017) emphasizes young workers to communicate confidently. In Korea as well, it is necessary to devise and actively promote the safety campaigns and guidelines for safety education/training for young workers. Especially, preventative measures for novice young part time workers including safety education/training need to be established. The results of this study are expected to be used to present polices or guidelines for accident prevention of food delivery workers' motorcycle crashes.

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Author listings

Jong Han Byun: mrbyun@kosha.or.kr
Highest degree: PhD Candidate, Hansung University
Position title: Professor, KOSHA, OSH Training Institute
Areas of interest: Ergonomics, Safety and Health Management, UX

Byung Yong Jeong: byjeong@hansung.ac.kr
Highest degree: PhD, Department of Industrial Engineering, KAIST
Position Title: Professor, Department of Industrial and Management Engineering, Hansung University
Areas of interest: Ergonomics, Safety and Health Management, UX

Myoung Hwan Park: mhpark@hansung.ac.kr
Highest degree: PhD, Department of Industrial Engineering, KAIST
Position title: Professor, Department of Industrial and Management Engineering, Hansung University
Areas of interest: Management Science, Innovation Engineering