

Shiftwork, Fatigue, and Safety Performance in the Mining Industry

WSN Mining Health and Safety Conference
April 7th, 2016



Your project. Our expertise. Common ground.



UNIVERSITY OF
TORONTO

Dumas Relationship with University of Toronto

Overall goal: *Achieve Sustainable Improvement of Safety Performance*

Shiftwork and Fatigue Study

- Objective: Investigate the impact of fatigue on productivity, incident rates, incident types, and existing dependencies and correlations between incidents and shift structure, camp conditions, worker experience, age, etc.
- Scope: Three gold mines in Timmins, Ontario and one site in Yukon.

Safety Climate Study

- Objective: Uncover current attitudes of the workers in the mining sector toward safety initiatives, labour safety training, risk aversion, peer impacts, and safety outcome.
- Scope: Three gold mines in Timmins. Collected 197 self administered questionnaires.

Fatigue Study: Research Methodology

- Collected Production, Hours, and Incident details for four Dumas mining sites.
- Data included: daily production, daily hours, incident type, date, time, shift, day in rotation, etc.
- Conducted in-person visits and interviews with Site Superintendents, Supervisors, Safety Personnel, and select workers for all four mines.
- Conducted additional safety surveys at one site (extension of previous project)
- Designed and conducted a pilot “fatigue-specific” survey at one site.
- Data Analysis:
 - Investigated the impact of fatigue on incidents based on Dumas data.
 - Analyzed the impact of fatigue based on survey statistics.

Scope & Projects Involved

In-town Mines

Project 1

Ontario

Project 2

Ontario

Camp Mines

Project 3

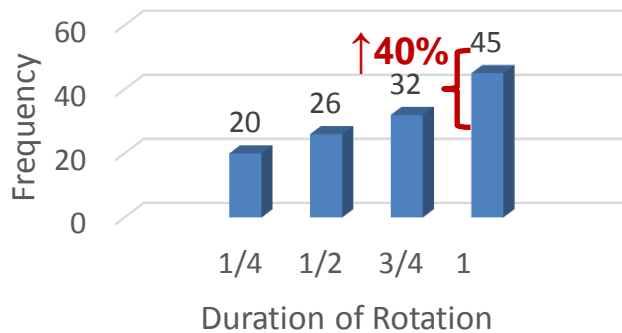
Ontario

Project 4

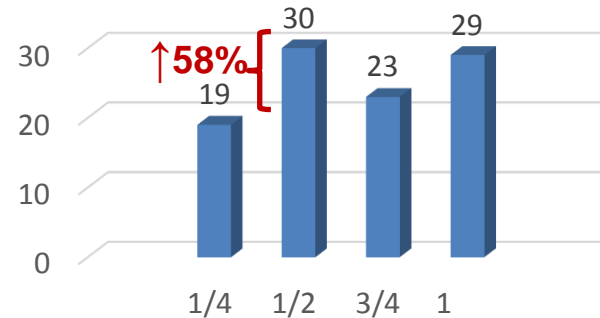
Yukon

Incidents by Time through Rotation

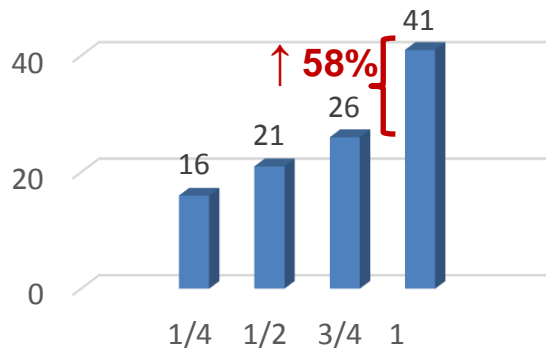
Project 1



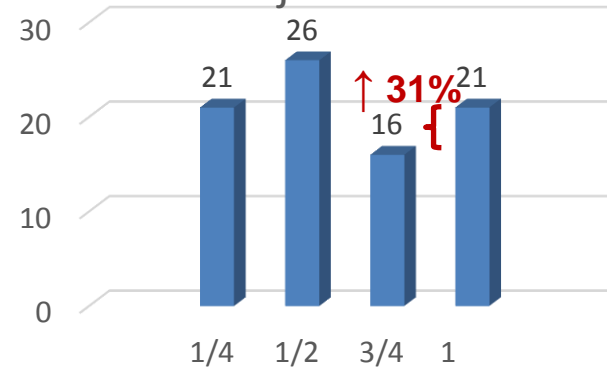
Project 3



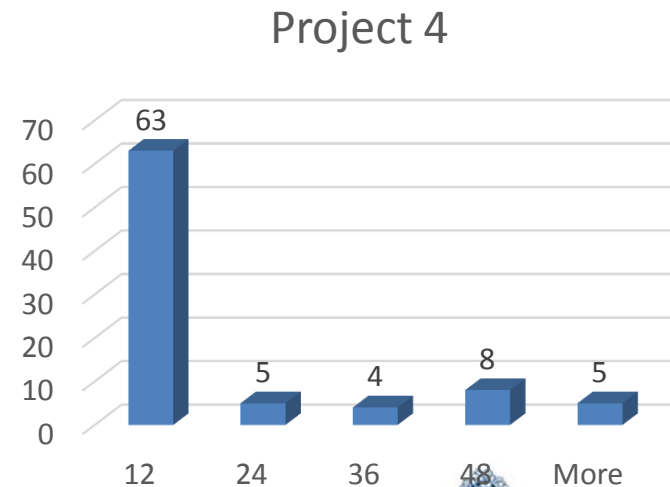
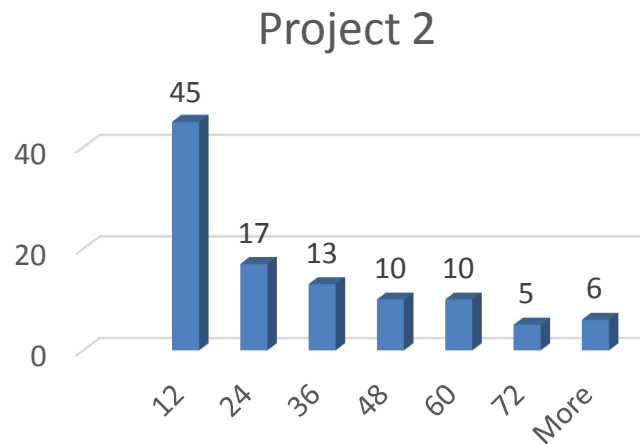
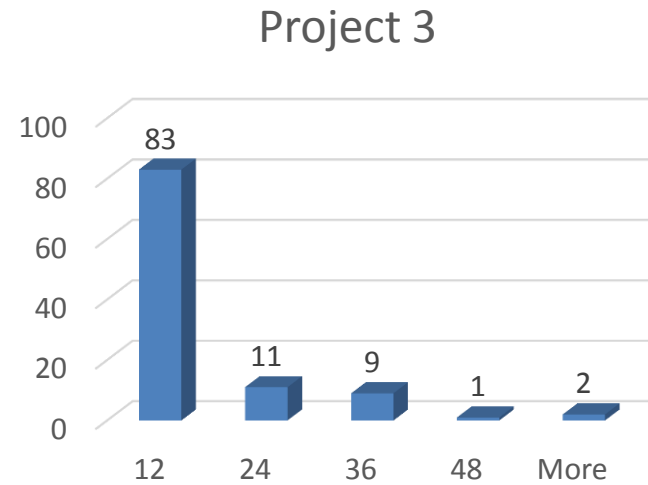
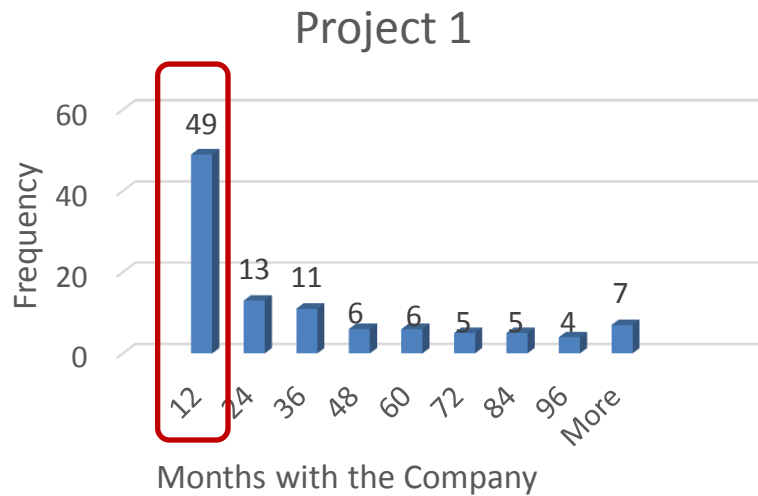
Project 2



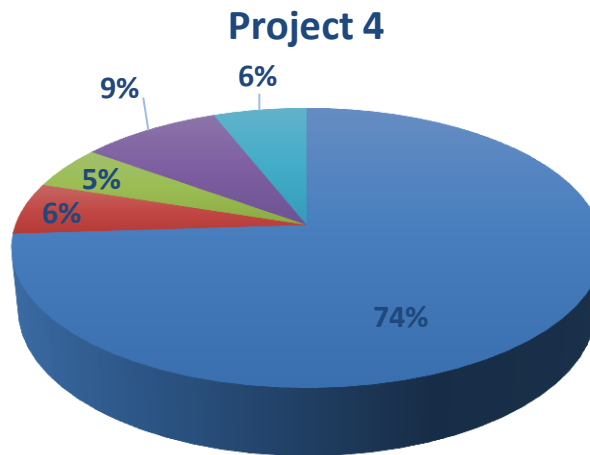
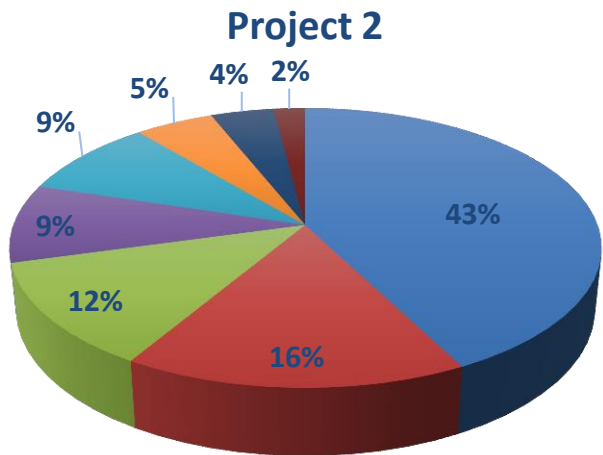
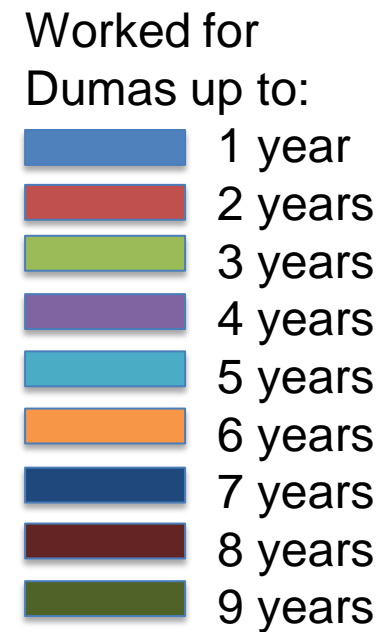
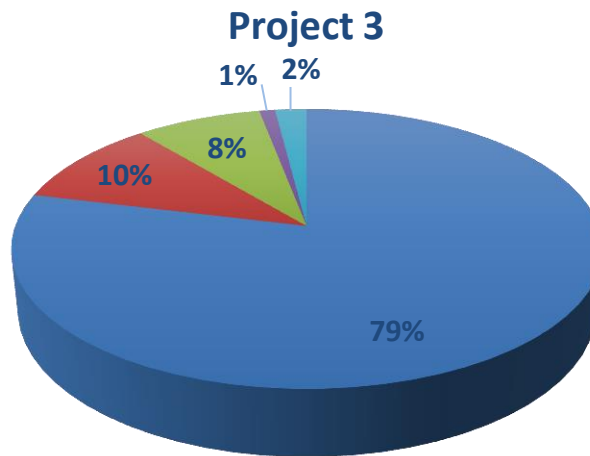
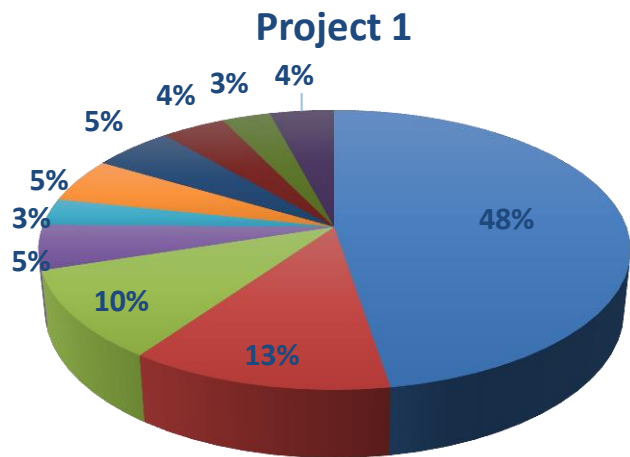
Project 4



Incidents by Experience (Months with Dumas)

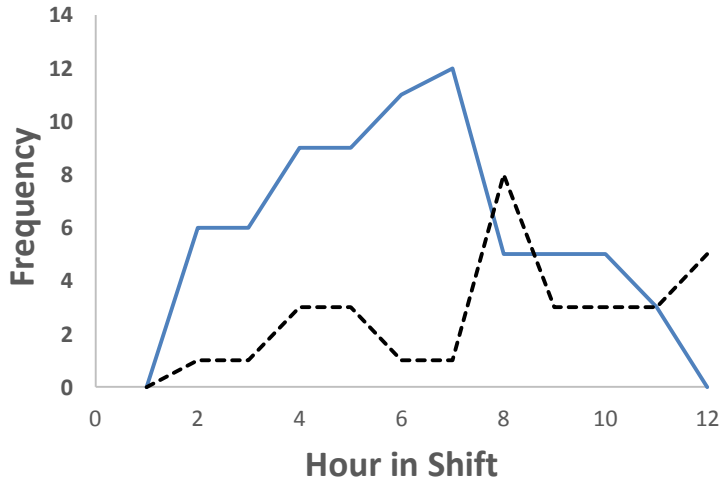


Incidents by Experience with Dumas

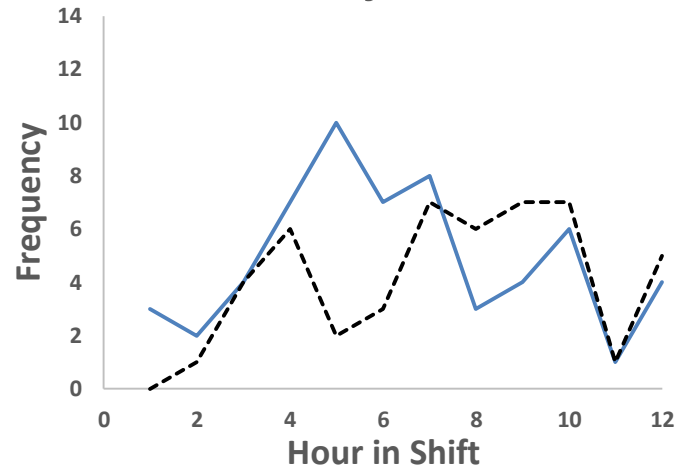


Time of Day

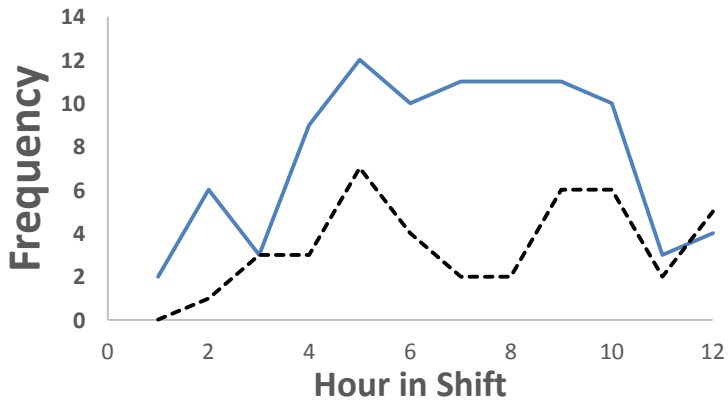
Project 1



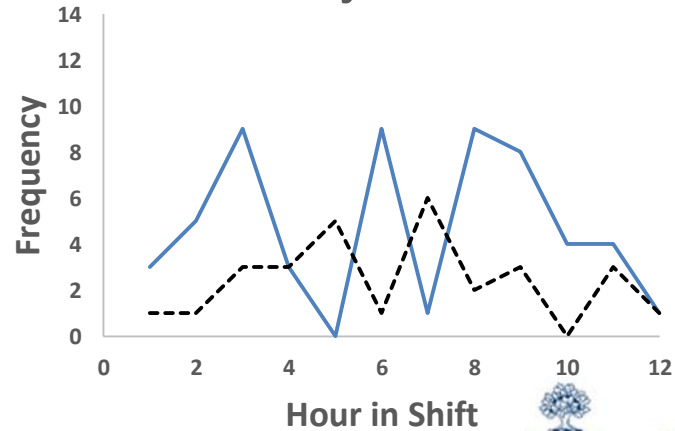
Project 3



Project 2



Project 4

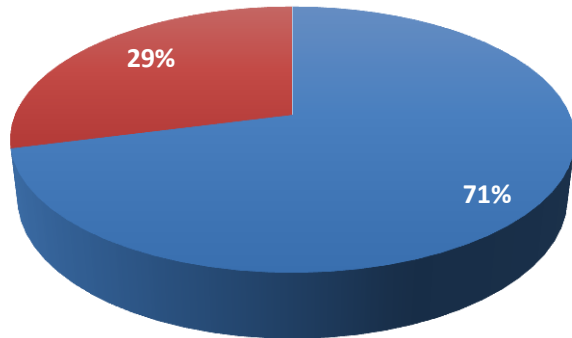


— Day Shift

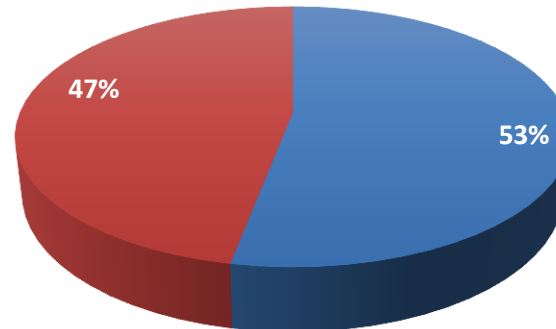
- - - - Night Shift

Incidents by Shift

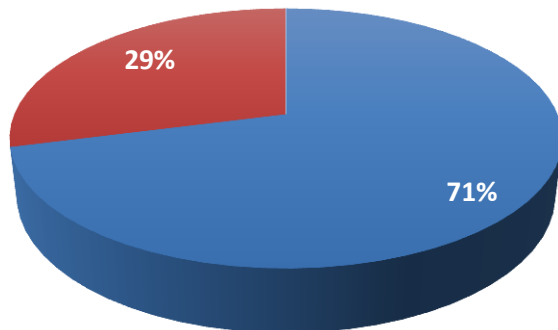
Project 1



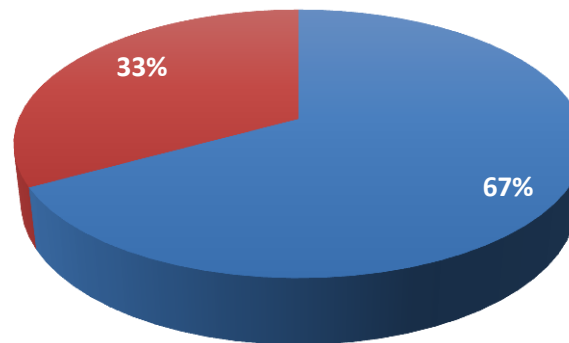
Project 3



Project 2



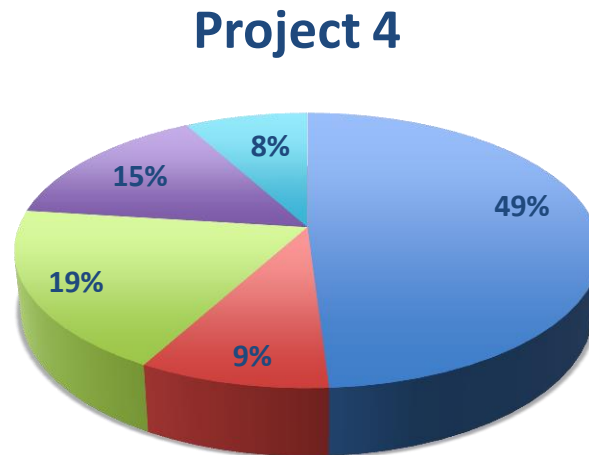
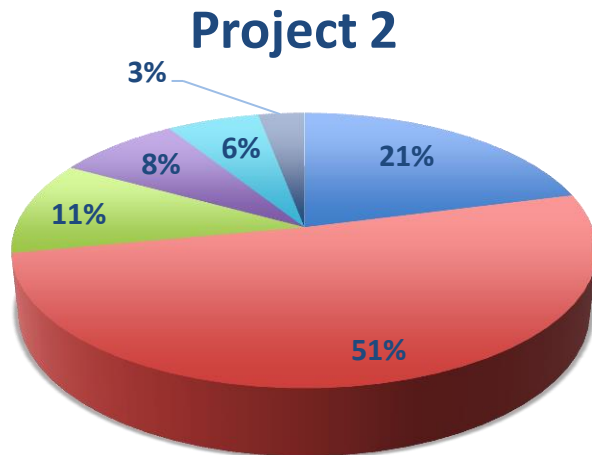
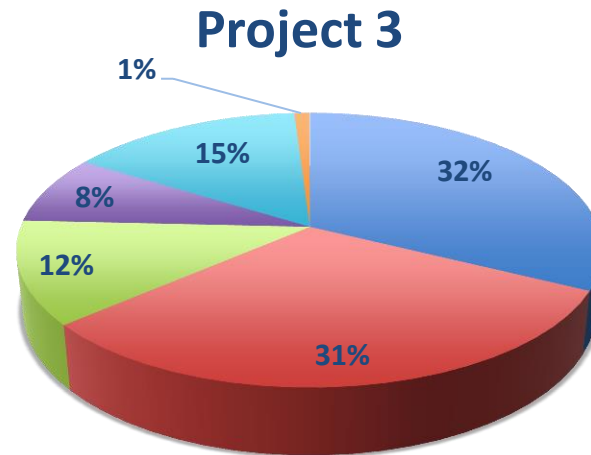
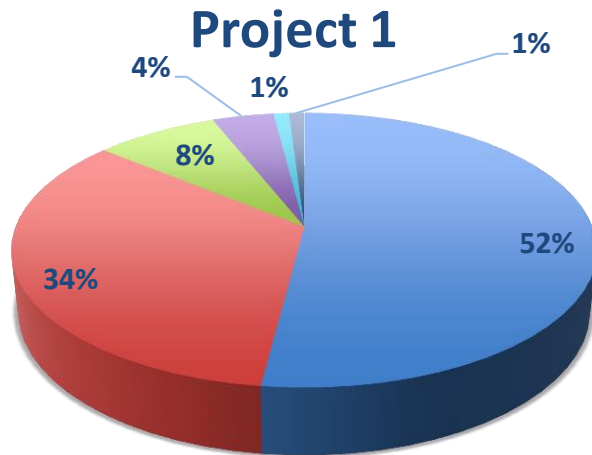
Project 4



■ Day Shift

■ Night Shift

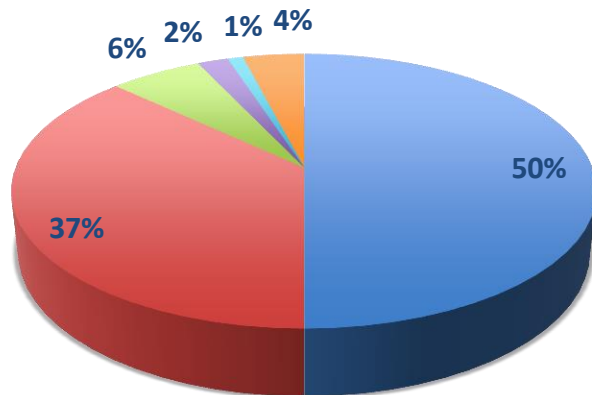
Incidents by Type



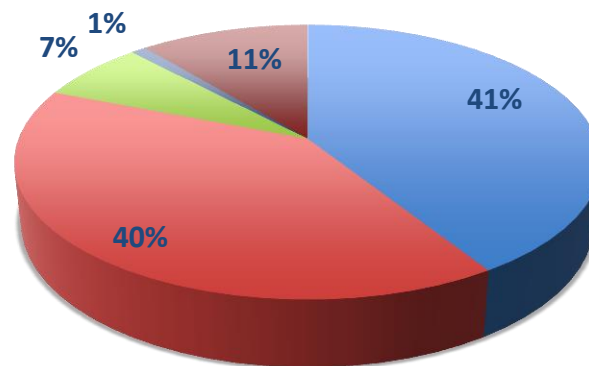
- Eqpt/Prpt Damage
- RO
- FA
- Near Miss
- RWI
- LTI
- MTI

Incidents by Trade

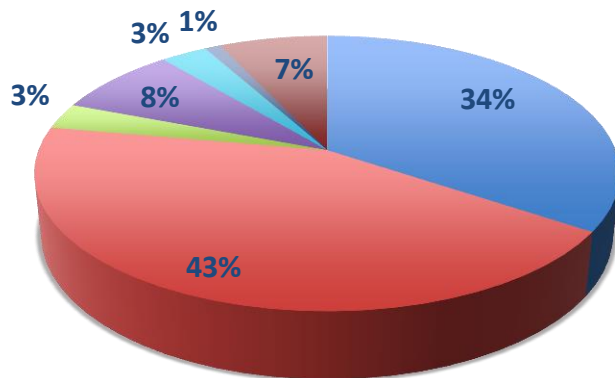
Project 1



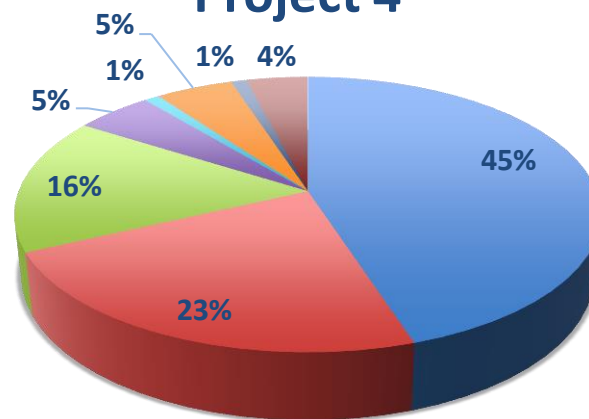
Project 3



Project 2



Project 4



- Operator
- Miner
- Mechanic
- Construction
- Electrician
- Supervisor
- Surveyer
- Not Identified

Survey Results

1. On average, workers take 2-3 breaks for more than 5 minutes (including lunch)
2. On average, workers drink 3-4 cups of coffee/tea during a shift
3. 51% of workers smoke for an average of 14 cigarettes a shift!
4. 30% of workers consume energy drinks, between 1-2 per shift.
5. 20% don't sleep well at all at camp.
6. 46% have trouble sleeping on the camp bed
7. 51% complaint about lack of AC and noise at camp
8. On average, workers sleep 6.4 hrs at camp and 7.6 hours at home
9. Most tiring shift mostly due to lack of sleep and camp conditions.

Conclusions

- On all four sites, the number of incident increases as the rotation duration progress (by as much as 58% from one quarter rotation to the next)
- Day/Shift consistently shows higher incident rates than night shifts (by as much as 145%)
- On average about 42% of all incidents are caused by Operators and 31% are caused by Miners
- In non-camp mines, about 44% of all incidents are caused by workers in their first year of employment.
- In camp mines, about 76% of all incidents are caused by workers in their first year of employment!

Safety Climate Study

Safety Climate refers to the perceptions that employees share about their working environments (Zohar 1980).

Safety Climate

Has the ability to influence



- 1) Improved work behaviors of compliance.
- 2) Reduction in injury severity and frequency.

Stone Example

People have different attitudes when facing problems.

1. Not aware



2. Avoid



3. Improve



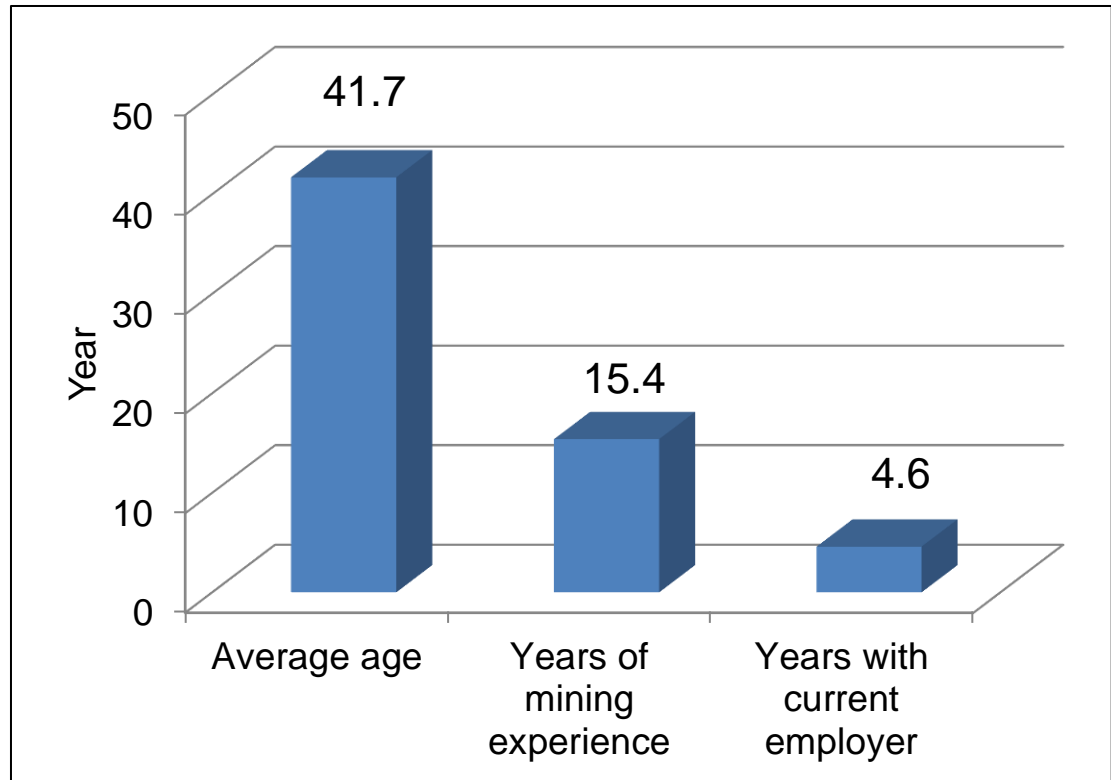
Research Target

Was based on a *group* of workers working on three project sites:

- The study gathered 200 surveys

Workforce make-up:

- Supervisor 13.3%
- Journeyman 80.4%
- Apprentice 6.3%

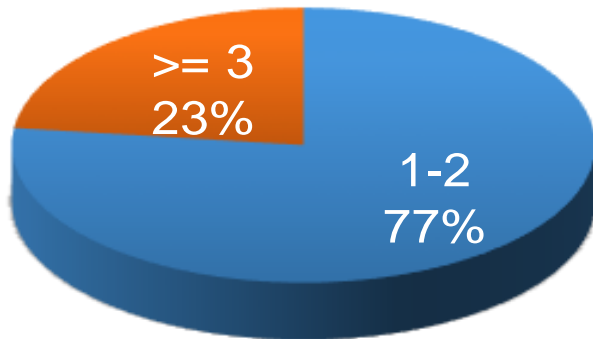


Research Target (cont.)

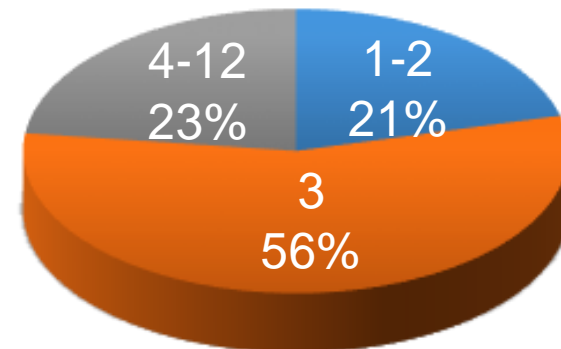
Mobile workers on mining sites:

- Workers that moved between employers and/or projects within a three year time period.

No. of employers in the past 3 years



Mobility (No. of projects in the past 3 years)



Research Instrument

GENERAL INFORMATION:

1. Gender: (circle) Male Female
2. Age: _____
3. What is your trade? _____
4. How long have you worked in mining? _____ YEARS
5. How long have you worked for this employer? _____ YEARS

Three parts are measured:

- Workforce demographics
- Attitudes toward safety
- Safety incidents

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
24. If I worry about safety all the time I would not get my job done	1				
25. I cannot avoid taking risks in my job	1				
26. Accidents will happen no matter what I do	1				
27. I can't do anything to improve safety in my workplace	1				
28. I always wear the protective equipment or clothing required on my job	1	2	3	4	5
29. I do not use equipment that I feel is unsafe	1	2	3	4	5
30. If I find some safety issues in my job, I will not continue the work until the problem is fixed	1	2	3	4	5
31. I inform management of any potential hazards I notice on the job	1	2	3	4	5
32. I know what procedures to follow if a worker is injured on my shift	1	2	3	4	5
33. I would know what to do if an emergency occurred on my shift	1	2	3	4	5

Self-administered surveys:
Worker
Supervisor

Attitudes Toward Safety

Positive Attitudes

- Conscientiousness
- Safety consciousness
- Job safety
- Co-worker safety
- Supervisor safety
- Management safety
- Safety program & policies
- Job involvement

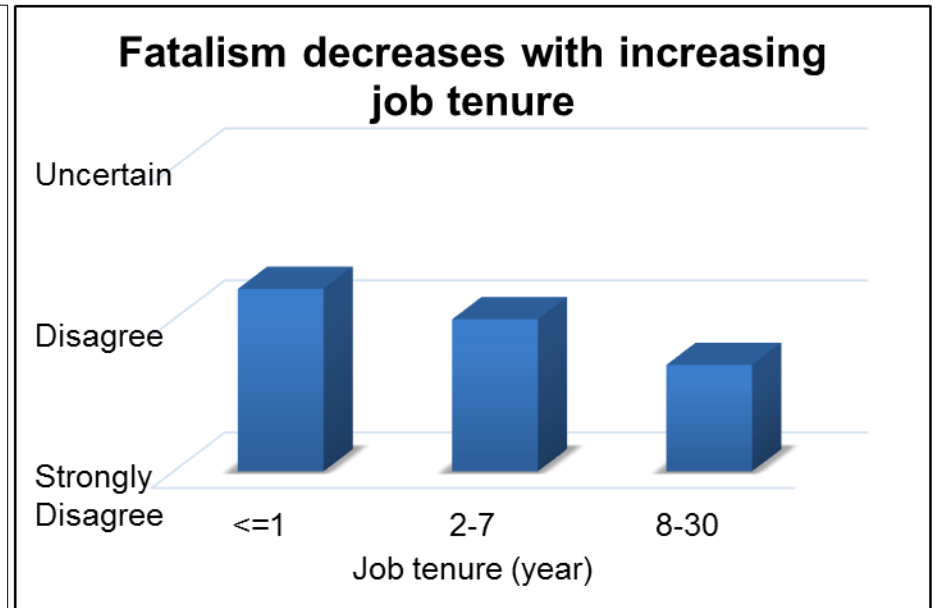
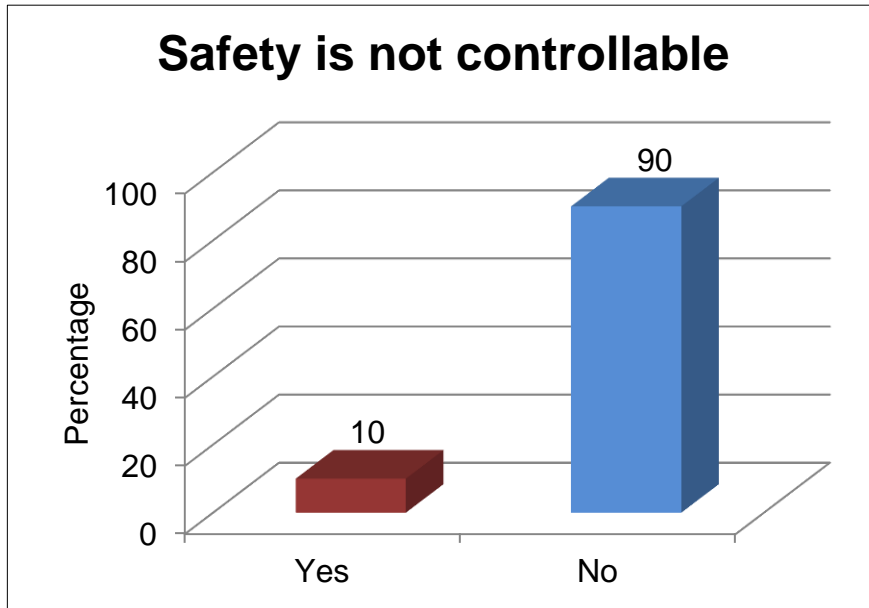
Negative Attitudes

- Fatalism
- Role overload
- Work pressure
- Interpersonal conflict at work

The attitudinal questions were scored from 1 (strongly disagree) to 5 (strongly agree).

Fatalism

A worker's view on the randomness or uncontrollability of incidents.

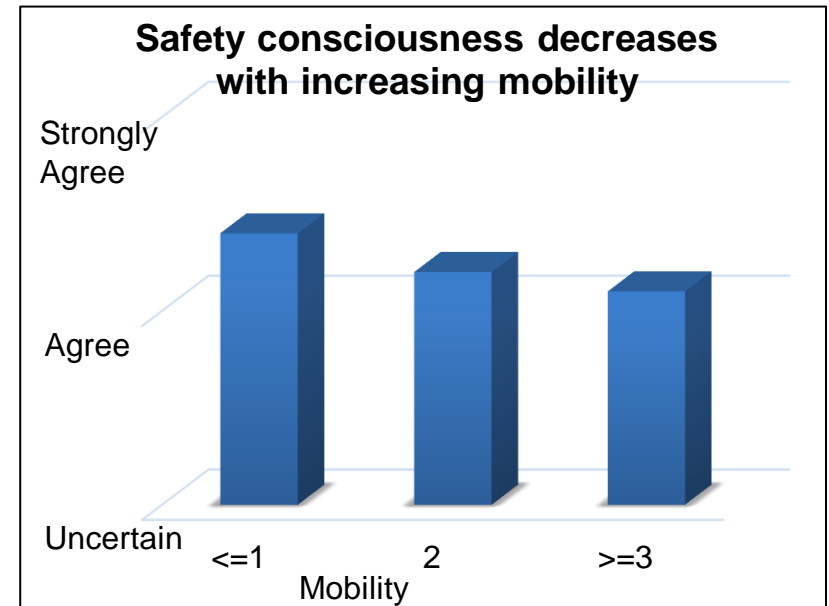
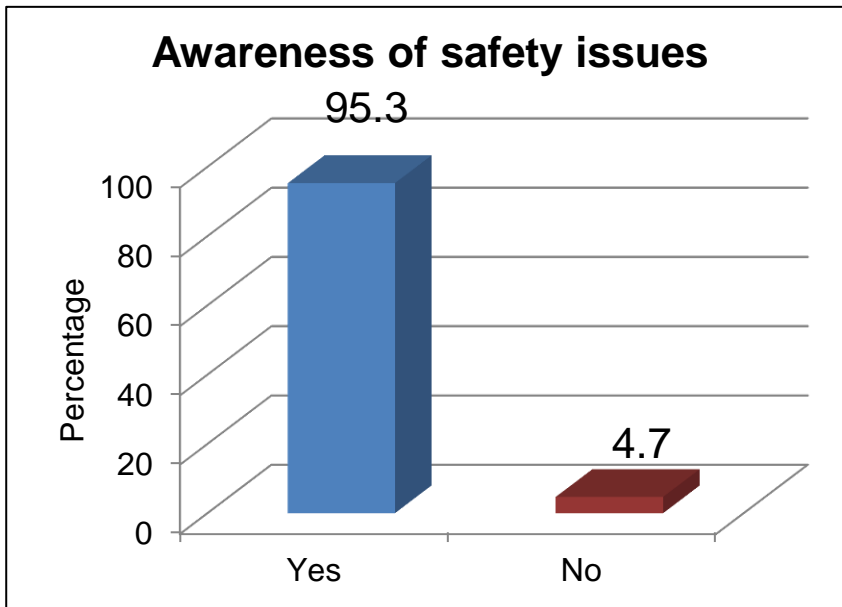


Fatalism 

Safety Incidents 

Safety Consciousness

One's awareness of safety issues in the workplace.



Safe Consciousness

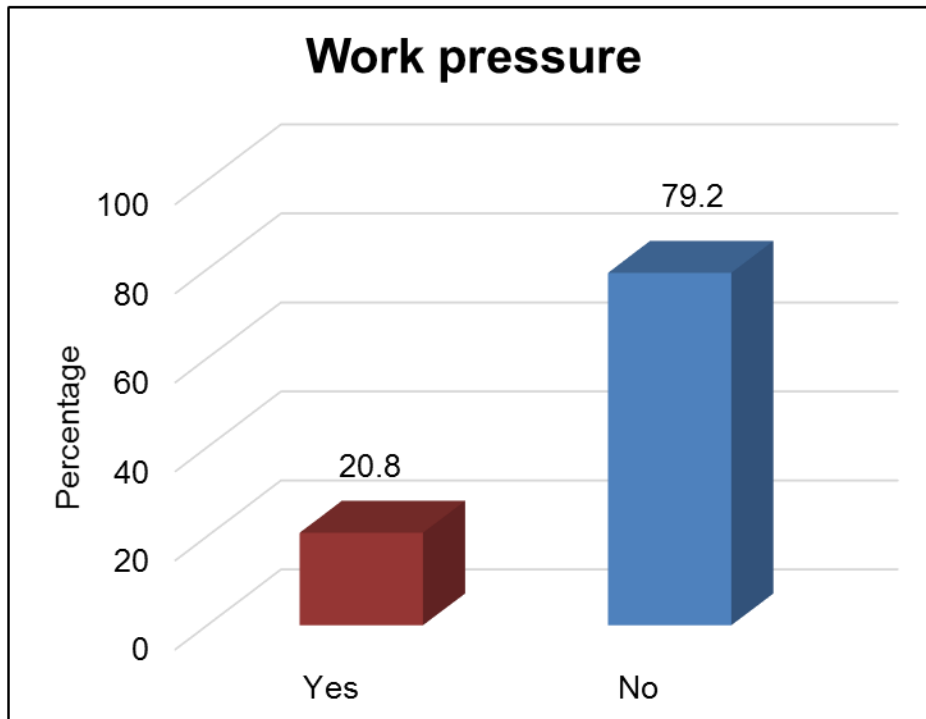


Safety Incidents



Work Pressure

A worker's belief that there is excessive pressure to complete work faster.



Work Pressure



Safety Incidents



Supervisor Safety

The worker's perception about their supervisor's safety practices.

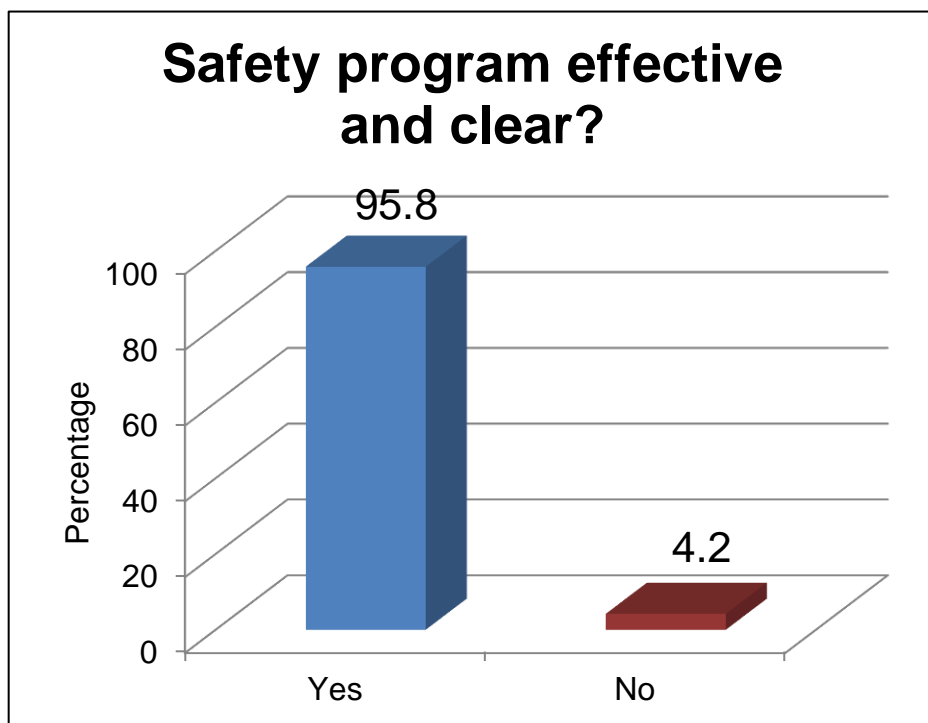


Supervisor Safety 

Safety Incidents 

Safety Program & Policies

A worker's perception about the effectiveness of safety programs and policies in workplace.



Safety Program

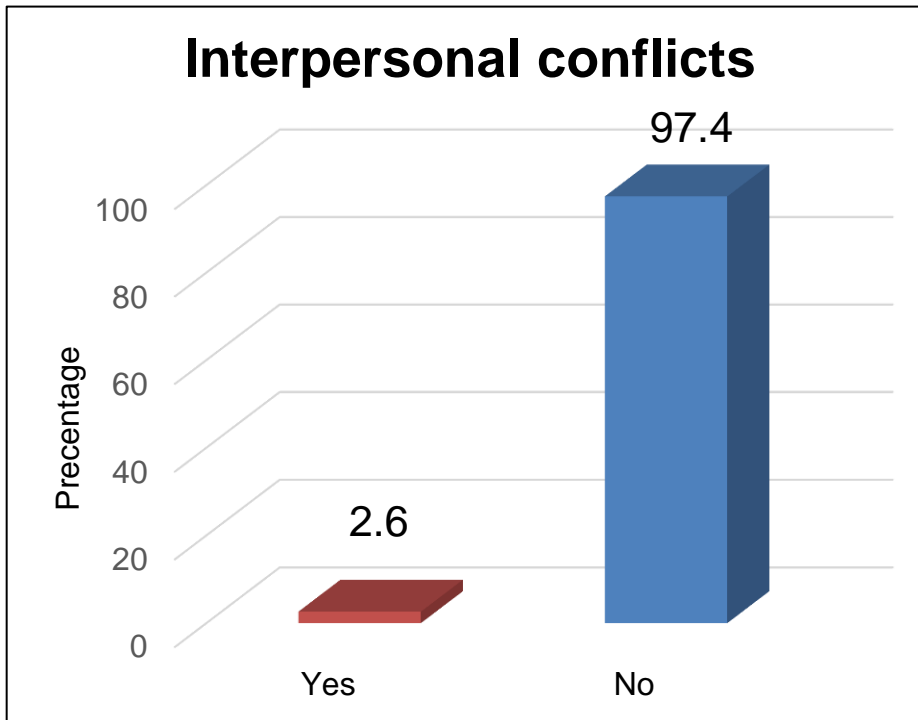


Safety Incidents



Interpersonal Conflicts

Interpersonal conflict at work is the degree to which respondents get along with others at work.



Interpersonal Conflicts

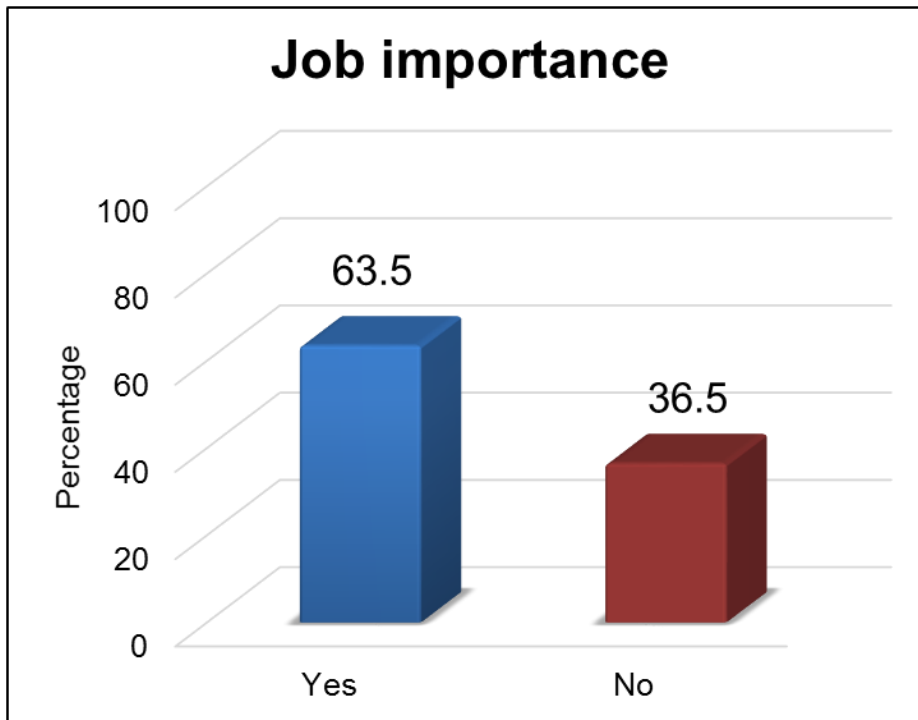


Safety Incidents



Job Involvement

Job involvement is one's beliefs regarding the importance of their work in their life.



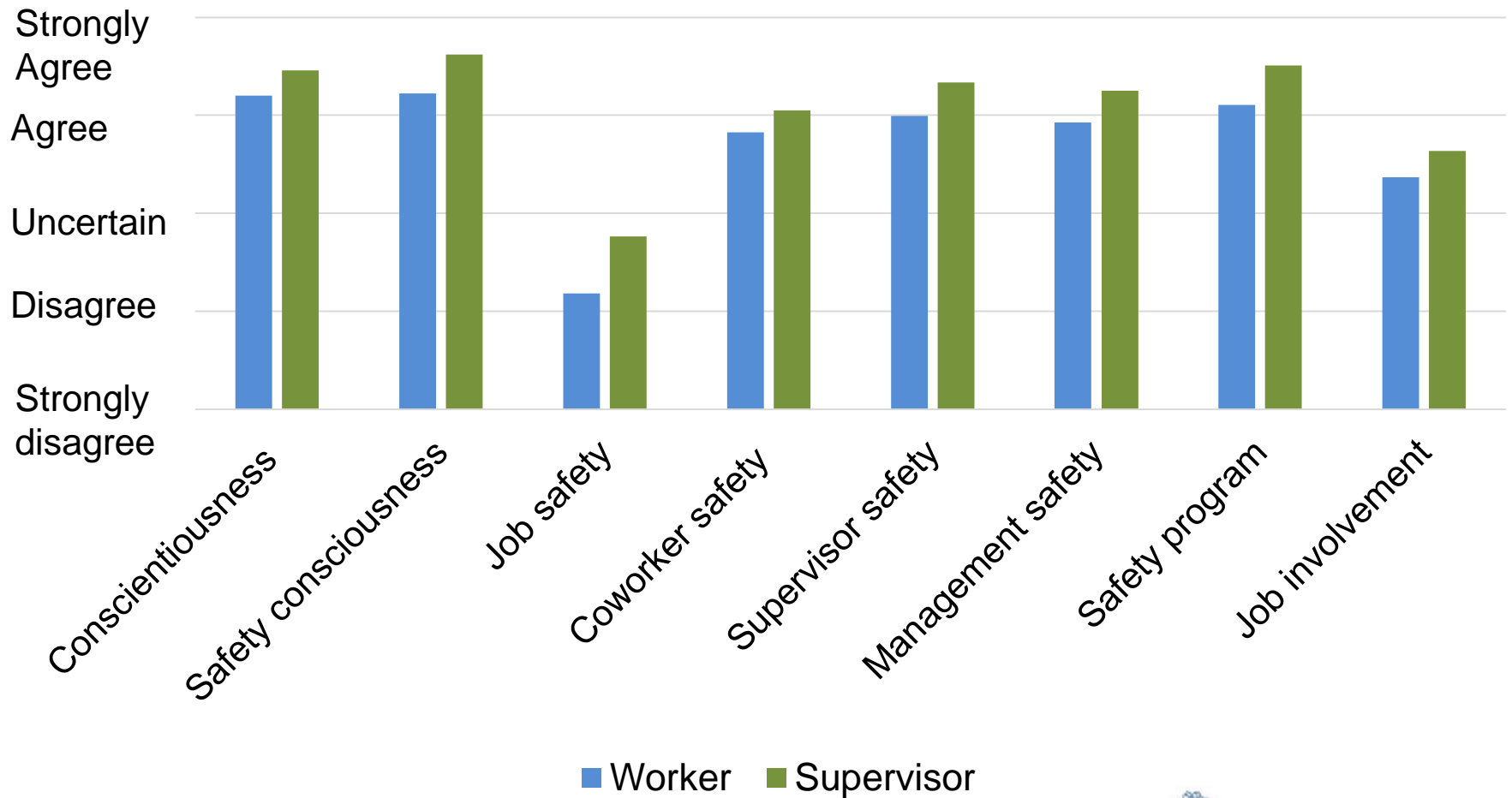
Job Involvement



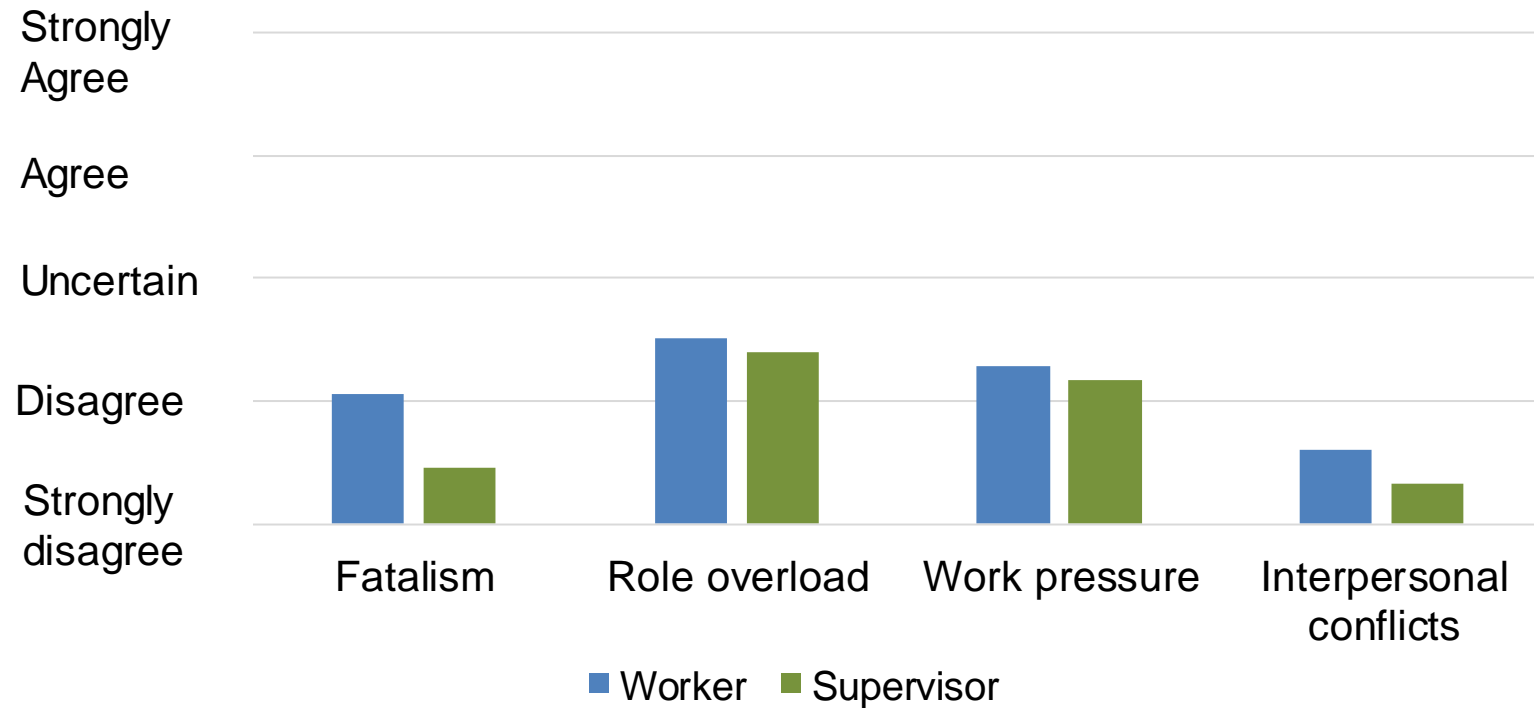
Safety Incidents



Worker vs. Supervisor



Worker vs. Supervisor (cont.)



Conclusion

Based on the responses by the workers, a positive safety climate on the three sites was found:

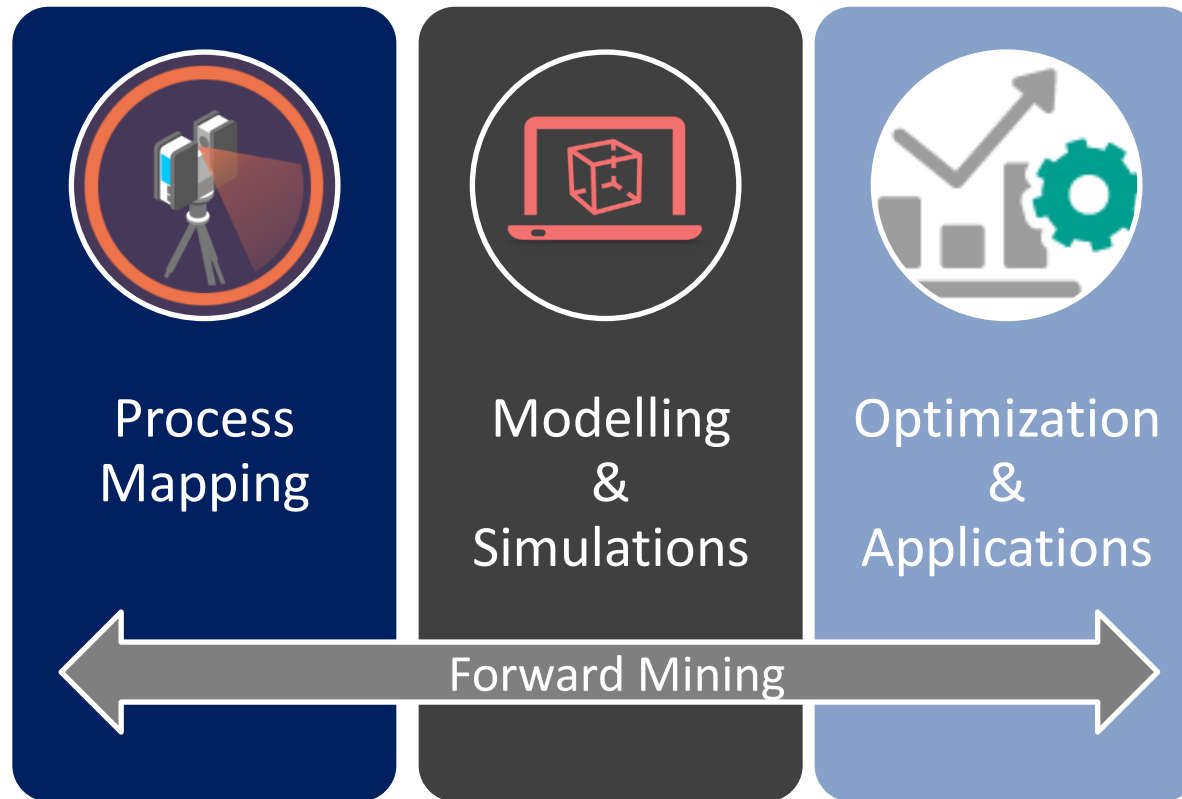
- 90% have control over safety.
- 95% are aware of relevant safety issues.
- 96% believed that safety programs are useful and clear.
- 79% believed that they have sufficient time to plan their work.
- 72% believed that their job contains risks, which indicates a high awareness of safety issues.
- Even though there was a level high mobility, workers felt safe due to management's leadership and approach to safety and the matured safety programs implemented at their workplace.

Recommendations

The following are Dumas' recommendations:

1. Apply continuous improvement ideas to enhance the safety culture of Dumas.
2. Implement programs to focus on the high frequency areas (first month/year of employment).
3. Promote mental and physical health of workers.
4. Reduce quantity and intensity of incidents by reducing worker fatigue.

Discussion – Potential Future Projects



Research Team



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**Our employees are
on loan to us from
their families...**

**... it is our responsibility
to return them safely.**

