APPLICATION OF
BEHAVIOUR BASED SAFETY IN MINES
Knowledge Report by
Indian Chamber of Commerce (ICC) & Consultivo

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Contributors:
SAMIR K Sadhu
MADHABI Guha
REESHIKA Rai
MEDHA Basu
BISWAJIT Ghosh
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The Mining industry has the potential to contribute 6-7% to National GDP but due to various reasons, the contribution has remained limited to two per cent. The recent amendment in the MMDR Act has brought in reforms and transparency in the mining industry in India. However, for a sustained high growth trajectory, acceleration in the approval processes, creation of conducive fiscal regime, enabling policy framework for promoting exploration and providing proper focus on the mining technology aspects are needed.

While there has been private sector participation in mining, the government through its various public-sector companies continues to be the largest participant in the domestic mining industry.

In India, there is a dearth of technological innovation in the mining sector. The mining companies are constantly striving to implement latest, reliable and cost-effective automation technologies for their mines, to ensure high productivity and safety. With the recent advancement in technology, especially with the application of IT, it is now possible to identify the variables for improving existing production of mine with reduced operational cost and ensuring a higher level of safety to the miners.

In India, the focus is to establish solutions in the core mining production processes of surface mining, underground mining, strategic resource development, resource and reserves estimation and mine planning. Even with these positive steps, there is a significant technology gap in the Indian mining sector as compared to global standards, both in terms of availability and usage of technology. High tax rates and poor equipment financing support are the major challenges.

In spite of the adversities, there lies a huge scope for the technology providers to come forward and meet this huge challenge of exploration in the area of mining technology in India.

Against this background, Indian Chamber of Commerce is organizing the 3rd India MineTech - A Seminar on Mining Technology on 6th March 2020 at Kolkata. The conference will focus on the current status of technology deployment in the mining sector and recent global advances in technology, and explore solutions that are best suited for the industry.

**Consultivo is the Knowledge Partner of this initiative.** I trust the conference would be able to generate new ideas and emerging thoughts among the various stakeholders to discuss, share and evolve suitable strategies and development models.
The mining sector in the country needs to urgently switch to responsible mining by improving its overall performance on safety, environment, social impact and skill development. With a tremendous amount of workforce employed at the mines, human health and safety should become a priority of mining organisations, as mining includes a lot of natural hazards which can be prevented by creating safe working conditions where safety is followed diligently. For the importance of safety to percolate across the workforce and for safe behaviour to be inculcated as their daily habit, the safety culture of the organisation has to transform into a positive one. Behaviour Based Safety (BBS) is a behavioural science model to help organisations achieve a positive safety culture, where causes of human unsafe behavioural patterns are properly identified and addressed, and a transformation is brought about in the safety behaviour of the employees, which helps them prioritise and practice safety at all times.

This knowledge report highlights the importance of safety in mines and the role of BBS in ensuring a strong safety culture and safe working environment across mines.

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Safety Hazards in Mining

Mining which includes extraction of mineral reserves results in varying degrees of environmental exploitation, resource depletion, health and safety problems for the workers, and displacement of local tribal communities of the region. Mining industries have highly unsafe and uncertain working conditions. The mining operations are prone to injury-related risks and in the worst situations even loss of human lives through hazards and accidents. Safety standards should be highly prioritized by regulators and mining companies in mining operations. The evolving nature of work related to mining is generating new occupational health hazards among the workers like asthmatic and allergic reactions, musculoskeletal diseases, stress and mental problems and, health hazards caused by exposure to hazardous agents.

If safety is neglected in mining activities, the probability of hazards and accidents increases. Mining sites face a lot of safety uncertainties and risks. The hazards associated with working in mines are different from other industries and working in especially underground mines is fraught with several hazards. Accidents are mostly prevalent in underground mining sites. Some typical hazards as witnessed at underground mines and open cast mines are:

- Blasting related accidents and accidents due to mishandling of explosives
- Methane and coal dust explosions
- Accidents related to machinery mishandling
- Accidents related to malfunctioning of mining equipment (like safety lamps, electrical equipment, etc.)
- Gaseous asphyxiatiion due to leaks of explosive natural gases like methane or poisonous gases like hydrogen sulphide
- Unstable underground mines leading to the collapse of mine stopes
- Flooding and inundation of mine sites
- Underground mines also have incidences of fire; ventilation failure; accidents due to mining-induced seismicity
- Opencast mines also face safety hazards like working face or bench collapse; caving in of roads and pathways; deep water accumulations in excavated spots; lightning strikes; poorly illuminated sites; operation and maintenance of HEMM such as loaders, excavators, shovels, dump trucks, rotary drills etc.
- The frequent transportation required also increases the probability of road mishaps

It is also important to ensure safety in the operation and maintenance of mining equipment. This can
be achieved by allowing only safe and authorized handling of mining equipment, developing Standard Operating Procedures (SOPs), and training the craftsmen and engineers concerned. The equipment to be used in mining has to comply with safety norms and require approval from the safety department of the mines.

Some of the commonly used mining machinery are listed below:

- Mine winder for materials and man hoisting (inclined & vertical shaft winder, friction winder)
- Air compressors
- Loaders (electric or pneumatic)
- Gate end boxes for power supply
- Battery and trolley wire locomotives
- Haulages for man and materials
- Scrapers
- Pumps (pneumatic or electric)
- Crusher and rock breaker
- Excavators, shovels, dump trucks, backhoe
- Drilling machine
- Tunnel boring machine
- Rock bolting machine
- Surface miners
- Forklift, hydra, mobile crane
- Exploders, ohmmeters
- Mine ventilation fans and blowers
- Miners cap lamp
- Miners gas testing instrument

Most of the accidents at the mine sites are due to safety violations and negligence in the behaviour of employees to follow safe working practices. Hazards at the mine sites can be minimized by following implementation of safety standards like OHSAS 18001 or ISO 45001, empowering safety leadership, providing adequate training and safety resources like PPE, and ensuring strict compliance to safety rules and regulations at the mine sites. However, for the employees to inculcate safe behavioural practices in their daily lives and for safety to be a core value among the workforce, the safety culture of the organisation has to be transformed to a positive one and this can be achieved by applying psychological and behaviour based intervention methods like the Behaviour Based Safety method.
Importance of Behaviour Based Safety (BBS) in mining

As mining activities include many safety uncertainties and risks, safety-critical organizations like mining companies have to proactively evaluate and manage the safety of their activities. Since people are involved throughout the life cycle of the mine from exploration to mine closure phase, their actions and omissions in their daily work activities account for most of the accidents. Major accidents are a result of unsafe acts and omissions of individuals who are directly involved in operation or maintenance work.

In a safety-critical organization like the mining industry, for safety culture to develop and progress, it is very important for safety to be perceived as a priority by the management and the employees. This can only be possible by changing the mindset of the people towards the significance of safety, thereby transforming their behaviour. Behaviour Based Safety plays a major role in the behaviour modification of people in considering safety as a necessity in their daily lives. Collaborative efforts from the employees and leaders towards ensuring a hazard-free workplace will foster a positive safety culture, where everyone considers safety as a priority. Employees contribute to a positive safety culture by actively participating in training and awareness programs on safety, and utilizing the knowledge gained in practicing safety at all times in the workplace, where hazards and risks are inevitable. By abiding with the safety rules and regulations in place, and reporting any near-miss cases and accidents, employees actively contribute to the progress of the safety culture. Employees can also aid the leadership team by acting as disciplinary agents for safety, where they can participate in safety audits and inspection. By the knowledge imparted from their leaders, they will be able to observe any unsafe practices in the workplace and report it and apply corrective actions immediately.

Measurement Criteria

Without any measurement criteria we cannot measure the effectiveness of any programme including Behaviour Based Safety (BBS) programme.

Normal safety standards rely on data from safety records which sometimes do not correlate with the actual conditions at the site. An effective measurement criteria is structured and effectively measures the implementation of the BBS programme, as it emphasizes on interacting with the employees to get information on their views and perceptions regarding safety; and also to conduct site observations to check unsafe acts and conditions, availability of safety resources, awareness levels and skills of the employees and the working environment.
How BBS can be implemented?

Implementation of a BBS programme requires the involvement of every individual in the organisation. It is not just the responsibility of the EHS head or the department. The top management should lead the programme and the EHS team can act as a facilitator.

**BBS can be implemented in the following 3 phases:**

a) Detection phase: In this phase, the Baseline Assessment is conducted.

b) Intervention phase: This phase is based on the outcome of the detection phase, where analysis is done and interventions are planned at the micro-level. Safety motivation and awareness courses are conducted for the employees.

c) Monitoring and measurement phase: This phase undergoes the process of periodic monitoring and action planning.

Across the BBS implementation phases and especially the Detection phase when the Baseline Assessment is conducted the following measures play a crucial role as explained below:

1. **Role of Data Collection in BBS Implementation**
   - Online and onsite/field Behaviour Based Survey is conducted to collect data from the relevant mine site which will implement the BBS program
   - The survey questionnaire is designed to furnish the insights on safety perception, safety climate and safety culture parameters of the organisation
   - The online survey is mostly conducted for the managers and supervisors, while the field interactions involve the workers employed at the mine site
   - An online safety leadership survey is conducted to evaluate the safety leadership performance of the leaders that contribute towards the maturity of the safety system in the organisation
   - The onsite/field Behaviour Based Survey includes behavioural observations that identify the unsafe acts and conditions at the mine site and, interaction with workers, management and supervisors through individual interviews and focus group discussions

2. **Role of Leadership in BBS Implementation**
   - The success of a BBS program depends on the safety leaders as they are responsible for promoting, modeling and reinforcing the safety programmes of their organisation
   - Safety leaders’ commitment to safety in their daily lives displayed by their
behaviour and actions influence their subordinates and peers to inculcate safety as a priority.

To implement a BBS program successfully, leaders have to undertake the following responsibilities:

a) Ensure safety as a top priority in the organisation
b) Conduct and attend safety meetings
c) Participate in potential severity assessment
d) Review unsafe acts and conditions of others
e) Follow H&S rules
f) Understand H&S risks and take decisions
g) Take a detail site visit
h) Engage individually with team members on safety
i) Follow ‘no tolerance’ policy for poor safety performance
j) Train people on H&S
k) Conduct lesson learnt sessions from incidents at other mines
l) Review key safety standard during site assessment
m) Involve in safety orientation of new hire
n) Start all meetings with a safety theme

3. Role of Safety Culture in BBS Implementation

- Safety culture encompasses shared values and beliefs of the organisation and its people
- The success of a BBS implementation program depends on the following safety culture aspects:
  a) Safe working habits of the employees
  b) Proactive actions by management on safety
  c) Top management involvement in safety programmes
  d) Discussion on errors to prevent reoccurring
  e) Ensuring the safety of the contractual employees
  f) Sense of responsibility for the safety of others
  g) Safety as a core value of the organisation
  h) Ensuring regular feedback on safety
  i) Prioritisation of accident awareness and prevention measures

4. Role of Safety Climate in BBS Implementation

- A positive safety climate is a result of shared prioritisation for safety in the organisation among all the employees which leads to a reduction in workplace accidents, injury rates and near-misses, and increase in safety performance
- The following determinants of a positive safety climate will ensure the success of the BBS implementation program:
  a) Effective communication on safety by the management
  b) Required support and action provided by the management to the employees on their safety concerns
  c) Supervision of the work and activities at the mine site
d) Penalties and punishments designed to motivate safety offenders to learn from their mistakes and prioritise safety at all times

e) Safety and well-being of the workers prioritized at all times, even during production pressure

f) Effective incident and near-miss reporting system

g) Management deals constructively with the employees and advises on safety improvements

h) Safety procedures are followed on all installation

i) Safe and quality equipment are installed

j) Quick approval of CAPEX for safety

k) The safety system is capable of preventing human failure

l) Trust in the employer/employee relationship

5. Role of Safety Perception in BBS Implementation

- To implement change, the perception gap between the management and front-line employees has to be bridged

- Safety perception helps in uncovering the strengths, weaknesses and perceptions of the organisation

- The elements of safety perception are:

  a. Attitude towards safety
  
  Attitude towards safety considers factors like positive & safe attitude of the employees towards safety; prioritisation of employees’ safety by the management; management’s commitment to safety displayed in their daily actions; safe working place where safety is regarded seriously by all employees; change in the orthodox beliefs of employees who associate any mishappenings to chance and think accidents cannot be prevented, towards importance and effectiveness of safe working procedures and safety.

b. Awareness programmes, communication and training

BBS implementation requires adequate employee training on safety that equips them to handle safety problems effectively and reduce accidents from occurring; safety awareness training sessions conducted for the employees; free flow of communication from the management on safety-related issues, safety goals, and procedures that employees understand clearly.

c. Discipline

Disciplinary factors like strict implementation of safety rules and procedures, positive reinforcement of safety and, fair handling of safety rules are applied while implementing BBS.

d. Goals on safety performance

Effective communication of safety goals and procedures has to be ensured by the management and, behaviour based safety goals should be formulated through discussion with all the employees.

e. Inspection, incident analysis and hazard correction

BBS implementation requires inspection, incident analysis & hazard correction, which includes factors like effective investigation of accidents and proper disclosure of its causes and lessons learnt to the employees; hazard reporting system in place to be effective for the use of the employees to easily report hazards and near-misses and
apply prompt measures to address it; clarity of safety procedures among the employees for them to understand the safety system in place and to support it; involvement of all the employees in hazard identification activities.

f. **Involvement of employees**
The involvement of employees in BBS implementation considers factors like the involvement of all employees in safety initiatives; prompt correction of unsafe acts and conditions during inspection; free flow of communication/feedback by the employees on their safety issues and concerns; effective reporting of accidents and injuries.

g. **Management credibility and supervision**
Management credibility and supervision also plays an important role in BBS implementation which includes factors like the management’s commitment to safety on providing safety resources and ensuring job safety; management’s involvement in safety programmes; management’s competence in accident prevention; safety discussions and meetings conducted by the management; management’s support for hazard correction and accident investigation; ideas and opinions on safety from the employees received by the management.

h. **Operating procedure**
Operating procedures help in managing the safety of the organisation and employees’ safety. Safety can be managed effectively in an organisation when there is an adequate number of safety procedures in place which are easily accessible to the employees and are followed for all activities. Accidents are to be considered seriously and accident prevention measures and reporting mechanism need to be clearly communicated to the employees.

i. **Recognition of performance**
To foster a positive safety culture and motivate employees to follow safety as a priority, it is important for the management to recognize, appreciate and reward good safety performance.
a) **Management’s commitment to safety**

A BBS programme will suffer if the management fails to commit to safety. Only when the management prioritises safety in their daily actions and decisions can safety percolate as a priority among the employees.

b) **Communication practices in the organisation**

When safety goals, principles, reporting and feedback mechanisms of near-misses and hazards are not communicated clearly across the workforce, the employees remain uncertain about safe working practices and find it difficult to observe, report and address unsafe acts and conditions. This results in the employees not considering safety seriously and being susceptible to risks and hazards at the workplace. Communication across the workforce has to be a two-way process, where the management clearly communicates safety necessities and the employees effectively report unsafe acts and conditions and voice their opinions and concerns regarding safety.

c) **Resource allocation for safety**

Inadequate provision of any kind of safety resources can undermine the management’s commitment to safety. The regular allocation of safety resources like Personal Protective Equipments (PPEs), plant modifications, equipment replacements, training
programmes, medical assistance, etc., should be regularly considered by the management. The management should also ensure that the CAPEX for safety is approved without any delays.

d) Employees’ attitudes and beliefs

Most of the employees deployed at the mine sites have orthodox views and opinions on uncertainties that happen at the site, like accidents and near-misses. They are found to associate any of such incidents to chance, fate, etc. This type of mindset of the employees makes them consider safety casually. Behaviour intervention in such cases becomes a challenge. While interacting with such employees, it is always advisable to talk about their family and peers in the conversation and how they will be impacted if the employee happens to be the victim of an accident. By including a personal touch while communicating with the employees, enhances their attitude and beliefs towards safety.

e) Safety awareness level of the employees

The safety awareness level of the employees can be improved by conducting safety awareness and training programmes, safety skills enhancement programmes, etc.

Challenges in implementing BBS in mines are mostly related to literacy and cultural background of the workers who are deployed to work at the mines, as most of them are from rural areas. The location of mines is also a challenge, as the mines are mostly located in remote and underdeveloped regions and forest areas. Skilled manpower is a requirement in working at mines but there is a short supply of skilled labour. Also, workmen who undergo training and skilling tend to leave for better opportunities. Mines employ outsourced or contractual workmen from agencies and these agencies fail to impart proper training on safety to the workmen who are most of the times ill-treated and exploited. Poor working conditions and improper health of the employees also impacts their safe working behaviour.

Many open caste mines are widespread and do not have boundaries to isolate the working areas, this becomes a major hurdle in ensuring a safe working site. Trespassers or locals usually come in close proximity to the mining areas or, use the common roads, which add to the safety risks and hazards. Considering all these major challenges faced in mines, a proper understanding, and stakeholder support is required for implementing BBS, which is a journey to reach zero accidents and zero injuries.

The following category of unsafe acts and conditions are typically observed in mines with a range of criticality levels (high risk, medium risk & low risk):

- Hazard identification
- Violation of operational procedures
- Working environment
- Personal protective equipment
- Knowledge/competency
- Inappropriate/ inadequate operational procedures
- Tools & equipment
Psychological factors affect the health and safety of individuals as well as their efficiency and productivity at work. Human behaviour is shaped by values, beliefs and culture and act as antecedents that trigger an individual to work safely or unsafely. Safety is influenced by human behaviour. Unsafe behavioural practices have led to many accidents. Humans have been responsible for 80-90 per cent of all industrial accidents.

To moderate, modify and transform human behaviour, psychological based behaviour analysis is applied. Psychological intervention methods mostly used in the industry are goal setting and performance feedback methods and application of reinforcements. Learning theories like classical conditioning theory, operant conditioning theory, cognitive learning and social learning theory are also applied to influence human behaviour at the workplace. To nurture human behaviour, intrinsic and extrinsic motivators are used. The designing process of the intervention programme requires identifying and considering the locus of control for human behaviour. Using the psychological intervention methods, onsite behavioural observations are carried out to capture the behavioural pattern of individuals at the mine sites. The onsite behavioural observations help in identifying unsafe acts and unsafe conditions at the mine site.

Safe behaviour depends on Antecedents and Consequences. Antecedents comprise of the following human, organisational and job factors:

- **Human Factors**
  - Values
  - Beliefs
  - Perception
  - Attitude
  - Social Pressures
  - Recognition

- **Organisational Factors**
  - Leadership
  - Management System
  - Policy/Procedure/Rules
  - Resources
  - Orientation, Training

- **Job Factors**
  - Risk
  - Tools & facilities
  - Equipment
  - Supervision
  - Competence

The behavioural consequences comprise of the following:

- Appreciation, recognition, reward
- Loss, accident
- Disciplinary actions
Accidents at workplaces are mostly caused by unsafe human behavioural practices. According to research, 96 per cent of all accidents are caused by human error and only 4 per cent due to unsafe work conditions. Behaviour Based Safety focuses on human factors and human behaviour and uses psychological behaviour intervention towards establishing safe working habits in the daily life of employees. It is an effective tool for the reduction of workplace accidents. Behaviour Based Safety (BBS) or behavioural safety approach helps in building a robust safety culture of an organisation. It helps in reducing accidents at the workplace and their associated human costs (if it is death or injury) and financial costs (damages to equipment, materials, products, etc.). Behaviour Based Safety (BBS) is not a one-time exercise and needs to be continued over time until safety culture transformation is well established and every individual in the organisation prioritises safety as a core value. Furthermore, BBS has to be pursued regularly for the existing employees and new incumbents joining the operations. BBS aims to change human behaviour towards the importance of safety and to foster a positive and open safety culture.

The safety culture of an organisation is reflected in the collective behaviour, values, attitudes and perceptions portrayed by the people in the organisation towards safety risks and negligence.
The safety management system of a company is largely influenced by a positive safety culture where safety is regarded seriously and safety principles are applied diligently. The overall culture of a company determines the company's safety culture which greatly impacts human behaviour in the organisation. Safety should be the core value and productivity driver of organisations. Only when safety is embedded into the cultural DNA of an organisation and safety becomes a core value among all the employees, can a safety culture develop progressively.

Positive safety culture in an organisation depends on the management and its leadership to induce operational health and safety as a core value of the organization. Leadership plays an important role in developing the safety culture of an organization. The safety culture of an organization is human behaviour-centric. The behaviour of the employees is influenced by the management’s leadership roles in ensuring a preventive approach towards hazards and risks. Management leading with integrity, and encompassing all the occupational health and safety rules in its leadership roles, will act as a beacon for positive reinforcement of safety culture in an organization. However, an organisation that has a negative safety culture includes employees who disregard the importance of safety and flout safety rules and procedures.
Conclusion

Safety is a phenomenon that is difficult to describe, measure, confirm and manage. When evaluating the overall safety of the activities, the effect of the management’s actions, working conditions and the culture of the organisation have to be considered. The safety performance of the employees affects the technical reliability of safety. Along with an improvement in the reliability of technical systems, human causes of accidents have to be considered, as most of the accidents are due to people’s behavioural or cultural factors.

Mining is prone to uncertainties like hazards and risks, therefore, it requires a strong safety measure in place. As a large number of people are involved in its working and operations, mining organisations need to focus on building a strong safety culture, where safety is prioritized by the entire workforce. Application of behaviour or psychological based intervention methods like Behaviour Based Safety (BBS), proves beneficial in identifying the root causes of unsafe behaviour, tackling the root problems and issues and transforming human behaviour to inculcate daily safe habits and actions; thereby building a strong safety culture which consists of shared values (what is important) and beliefs (how things work) among the workforce that interact with the organisation’s structure and control systems to produce behavioural standards (the way of doing things).
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Founded in 1925, Indian Chamber of Commerce (ICC) is the leading and only National Chamber of Commerce operating from Kolkata, and one of the most pro-active and forward-looking Chambers in the country today. Its membership spans some of the most prominent and major industrial groups in India. ICC's forte is its ability to anticipate the needs of the future, respond to challenges, and prepare the stakeholders in the economy to benefit from these changes and opportunities.

Set up by a group of pioneering industrialists led by Mr. G D Birla, the Indian Chamber of Commerce was closely associated with the Indian Freedom Movement, as the first organised voice of indigenous Indian Industry. Several of the distinguished industry leaders in India, such as Mr. B M Birla, Sir Ardeshir Dalal, Sir Badridas Goenka, Mr. S P Jain, Lala Karam Chand Thapar, Mr. Russi Mody, Mr. Ashok Jain, Mr. Sanjiv Goenka, have led the ICC as its President. Currently, Mr. Mayank Jalan is leading the Chamber as its President.

ICC is the only Chamber from India to win the first prize in World Chambers Competition in Quebec, Canada. ICC's North-East Initiative has gained new momentum and dynamism over the last few years. ICC has a special focus upon India's trade & commerce relations with South & South-East Asian nations, in sync with India's 'Look East' Policy, and has played a key role in building synergies between India and her Asian neighbours through Trade & Business Delegation Exchanges, and large Investment Summits.

ICC also has a very strong focus upon Economic Research & Policy issues - it regularly undertakes Macro-economic Surveys/Studies, prepares State Investment Climate Reports and Sector Reports provides necessary Policy Inputs & Budget Recommendations to Governments at State & Central levels.

The Indian Chamber of Commerce headquartered in Kolkata, over the last few years has truly emerged as a national Chamber of repute, with full-fledged offices in New Delhi, Mumbai, Guwahati, Ranchi, Bhubaneshwar & Hyderabad functioning efficiently, and building meaningful synergies among Industry and Government by addressing strategic issues of national significance.

**Head Office**
Indian Chamber of Commerce
ICC Towers, 4 Indian Exchange Place, Kolkata 700001
P +91 33 2230 3242-44 F +91 33 2231 3377/80 E sg@indianchamber.net

**Northern Regional Office**
807, Kailash Building, 26 Kasturba Gandhi Marg, New Delhi 110001
P +91 11 4610 1431-38 F +91 11 4610 1440/1441

**Western Regional Office**
1007, 10th Floor, Samartha Vihar, Off New Link Road, Oshiwara, Andheri West, Mumbai 400093
P +91 22 6127 7443 F +91 22 6888 8656

**Odisha State Office**
8BDA – H16 23, Opp Hotel Pal Heights, Jaydev Vihar, Bhubaneswar 751 013
P +91 674 253 2744/4744 F +91 674 253 3744

**Jharkhand State Office**
181 C, Road No 4, Ashok Nagar, Ranchi 834002
P +91 651 606 3236 F +91 651 224 3236

**Tripura State Office**
Kushan Plaza, 1st Floor, Above Mukesh Hyundai Showroom, Ganeshguri, Guwahati 781006
P +91 361 246 0216/4767 F +91 361 246 1763

**Assam State Office**
181 C, Road No 4, Ashok Nagar, Ranchi 834002
P +91 651 606 3236 F +91 651 224 3236

**Tripura State Office**
Department of Industry and Commerce, Khejur Bagan Kunjaban 6 Near Ginger Hotel, Agartala, Tripura (West)
P +91 88601 28904

**Telegana State Office**
TSR Towers, 6-3-1090, B Block, Ground Floor, Raj Bhavan Road, Hyderabad 500 082
P +91 40 4857 0788

**North Bengal & Sikkim Office**
Radha Apartments, 7th Floor, ISKCON Mandir Road, Siliguri 734001
P +91 80177 30407

www.indianchamber.org