Memorandum of Understanding

Indian Institute of Technology Kharagpur
represented by Dean of Sponsored Research & Industrial Consultancy

Prof. Dr. Pallab Dasgupta
Indian Institute of Technology, Kharagpur
Department of Computer Science and Engineering
Room No: 209, First floor,
West Bengal, India 721302

- hereinafter referred to as "Partner" –

and

Technical University of Munich
represented by its President
80290 Munich, Germany

hereinafter referred to as "TUM" -

(each a "Party" or collectively the "Parties")

enter into the following agreement ("Agreement") for research collaboration in the field of

FUTURE TRANS: Joint Indo-German Collaborative Research Center on Intelligent Transportation Systems

Purpose:

The purpose of this Memorandum of Understanding is to jointly establish an Indo-German collaborative research center (hereafter called CENTER) focusing on the future transportation technologies that are relevant for Indian cities by the Indian Institute of Technology (IIT) Kharagpur and Technical University of Munich (TUM) for a period of five years with a possibility of further prolongation. The Center will initially be physically located at IIT Kharagpur with a possibility of setting up a counterpart in Germany later. Moreover, the Center will host researchers from Germany – both from academia (such as TUM) and also from the industry. IIT Kharagpur is committed to provide the necessary space and the infrastructure for establishing this center. This MoU confirms the willingness of the two institutions to work together in the area of future transportation technologies relevant to the Indian smart cities. The approval of any project will be subjected to the availability of funds.

Article 1: Scientific goals of CENTER

In general the research goals of the CENTER can be broadly grouped in to the following three categories.

1. **Integrated end-to-end public transportation**
   Several modes of public transportation such as buses, trams, suburban trains, underground trains, auto rickshaws, taxis, and also ferry services, are available in many Indian cities. However, public transportation is still considered not reliable and comfortable due to the unpredictable traffic conditions. As a result of this, there has been a dramatic increase in the usage of private cars in India over the last 10 years, severely congesting the roads and significantly impacting the air quality. Therefore, future transportation solutions in India have to take a holistic view of the different options available and study integrated end-to-end solutions to make it more reliable and comfortable.

2. **India specific automotive technology**
   The number of German cars and buses on Indian roads has continuously increased over the past years. However, these vehicles were originally not designed for Indian road conditions and usage patterns. Many German cars available in India, in order to save costs, have reduced safety features compared to those in corresponding models in Germany. Instead, it is important to develop India-specific technologies if Germany aims to become a leader in the Indian automotive market.

3. **Collaboration of Indian software and German automotive companies**
   Nowadays, software-intensive systems constitute 70-90% of the innovation in modern cars. This shift in innovation from mechanical engineering to electronics, and mostly software, in the automotive domain is predicted to continue in the future as technologies such as electric vehicles and autonomous vehicles continue to mature. While India has developed into a major software engineering hub during the past years, there are considerable differences between, e.g., business, banking and financial software, where India has a leadership position, and software for technical systems such as cars. While there are very strong business cases for partnerships between German automotive companies (both OEMs and suppliers) and Indian software firms, and a considerable volume of automotive software development is already happening in India, there are significant advantages of more closely cooperating in this area in order to mutually benefit from the complementary expertise of the two countries.

In summary, an Indo-German collaboration in the domain of automotive and transportation technologies is meaningful because of (i) the complementary strengths of Germany and India in automotive technologies and software engineering and the growth of software-based functionality in cars, (ii) the need for developing new India-specific technologies, given the growing automotive market in India, and (iii) the opportunities that exist in the transportation segment in India in terms of building new infrastructure, introducing green technologies and providing integrated solutions in which the German industry could play a prominent role.

Article 2: Objectives of the CENTER

The research focus of this Center is to study future transportation technologies that are relevant for Indian cities as outlined in the above-mentioned scientific goals. In this phase, methodologies for establishing such a research Center will be investigated and the groundwork for the efficient functioning of day-to-day activities of the Center will be formulated. For instance, identifying how such a Center would function on a daily basis, from where will it get its funding, how can participants join and leave, what will be the financial commitments of the participants, how will IP rights be managed, what will be the exact modus operandi of the Center such that all the participants – both academic and industrial ones – benefit, how should governmental policy makers and also the management of the industrial participants be involved, are some of the many issues that will be investigated. In addition, this project will also analyze techniques for the sustaining such a Center in the long-term mostly through funding from the industry (both from India as well as from Germany) and also from Indian and German governmental funding agencies.

Article 3: Activities of this research CENTER

The activities of the center will initially consist of joint meetings and workshops between the two institutions, along with other members of the industry and other interested academic institutions from Germany and India. Multiple faculty members from both the participating institutions – TUM and IIT Kharagpur, and several industry partners both from India and Germany will also be involved in the discussions and workshops. The purpose of these joint meetings and workshops will be to exchange ideas for conceptualizing how such a center will be structured and how it would function beyond the 5 years of this project. Furthermore, in this project, there will be mutual visits – researchers from Germany will visit IIT Kharagpur and Indian industry partners, and those from India will also visit TU Munich and partners from the German industry. There will also be joint workshops organized in India and Germany and student exchanges between TU Munich and IIT Kharagpur. These activities will be funded by the recently awarded research project to TUM (Indo-German Collaborative Research Center on Intelligent Transportation System) funded by the BMBF of Germany.

Article 4: Anticipated Benefits of the research CENTER

The benefits of the proposed research Center are multifold. Germany is heavily invested in its automotive industry and mobility solutions in general. India is a world leader in software technologies and the strong impact of software-based solutions both in individual vehicles, and on the transportation sector in general (e.g., within the broader domain of smart cities) is now well established. Hence, strong

partnerships between these two countries in this domain – not only at the level of business organizations – but also at more fundamental levels between academic institutions will be very beneficial in the long term future. Further, India presents a huge business opportunity to the German automotive industry, but for which customized solutions that solve India's problems are needed. Finally, India also needs new solutions for its transportation and infrastructure-related issues, and to address them a strong partnership with the German academia and industry would be helpful. The proposed project – through the discussions and exchanges – will serve as a good platform for a bigger effort to both exploit and address the above opportunities and issues.

The Center will potentially setup joint Doctoral programs, and later possibly joint Master's programs on Automotive Systems and Software, and Intelligent Transportation Systems. Here, we plan to leverage the considerable amount of experience that TUM has with joint Doctoral and Master's programs in Singapore, with the National University of Singapore (NUS) and the Nanyang Technological University (NTU). As a precursor to setting up such joint degree programs, faculty members from IIT Kharagpur would visit TUM as Guest Professors and offer courses, with corresponding arrangements for TUM faculty members to visit IIT Kharagpur and offer guest lectures and courses. This project will also facilitate various forms of personnel exchanges between the two participating institutions – senior researchers and doctoral students will visit for varying durations, Bachelor's and Master's students will get the opportunity to conduct their theses at the partner institution and opportunities will be provided for students to spend an exchange semester at the partner institution.

In addition, to the collaboration between the several academic institutions, this research Center will also encourage industry participation. The participating industries advise on the long-term sustainability of the Center. Such industry collaboration facilitates the Center in a long-term where the participating industry can fund a doctoral candidate or provide technical support regarding critical field data that could be difficult to obtain in an academic research environment. Moreover, the participation of industries from both India and Germany also provide students with an opportunity to conduct their thesis at a partner industry or spend a sufficient amount of time at a suitable industry in the host country.

Article 5: Intended Activities of Partnering Institutions

Intended Activities of IIT-Kharagpur:

1) IIT Kharagpur is planning to provide the necessary built-up space for setting up the CENTER in its academic premises for the duration of this agreement.

2) IIT Kharagpur intends provide the rooms and infrastructure for hosting joint workshops, local support for hosting visitors from Germany.

3) IIT Kharagpur will actively engage its own faculty members in this CENTER.

4) IIT-Kharagpur will encourage its faculty members to visit TU Munich as Guest Professors and offer courses.

5) IIT Kharagpur is well connected to the Indian industry and has been active in research on automotive systems and software technologies. Since 2007 IIT Kharagpur hosted and ran the General Motors-IIT Kharagpur Collaborative Research Laboratory on Electronics, Controls and

Software. It also maintains close ties with the Indian automotive industry – such as Tata Motors, Mahindra and Maruti Suzuki – and also with major software engineering companies like Tata Consultancy Services, Wipro, and Infosys. Therefore, IIT Kharagpur will actively approach Indian companies to encourage them to participate in this joint Indo-German research Center for gathering additional funding and to support the Center in a long-term.

Intended Activities of TUM:

1) TU Munich intends to focus on methodologies for establishing such a research Center and formulating the groundwork for the day-to-day activities together with IIT Kharagpur.

2) TU Munich is planning to organize several joint meetings, workshops and seminars between the two institutions, along with other members of the industry and other interested academic institutions from Germany and India.

3) TU Munich intends to explore in partnership with IIT Kharagpur, methodologies for the long-term sustainability of this Center beyond the 5 years of this project mostly through funding from the industry (both from India as well as from Germany) and also from Indian and German governmental funding agencies.

4) Furthermore, TU Munich intends to host faculty members from IIT Kharagpur and organize short-term courses on different aspects of automotive and transportation technology in Germany.

5) In addition, it is intended that students from IIT Kharagpur can visit TU Munich for completing their internship programs and theses. These activities will be funded by the recently awarded research project to TUM (Indo-German Collaborative Research Center on Intelligent Transportation System) funded by the BMBF of Germany.

6) TU Munich is also planning to explore avenues for setting up joint Doctoral and Master's programs on Automotive Systems and Software, and Intelligent Transportation Systems by leveraging on the prior experience it has with joint Doctoral and Master's programs in Singapore, with the National University of Singapore (NUS) and the Nanyang Technological University (NTU). Moreover, TU Munich is extremely active in the domain of transportation technologies and also automotive systems and software. There are several faculty members in Electrical and Computer Engineering, Computer Science, Mechanical Engineering and Civil, Geo and Environmental Engineering who work on various aspects of automotive systems, and also transportation systems in general, who have expressed interest in engaging in the proposed research Center.

7) Faculty members of the TUM maintain strong connections with the local industry that includes automotive OEMs such as BMW, Audi and Daimler, and also suppliers such as Bosch, Continental and Infineon. They intend to actively try to engage industry partners to join this research Center for ensuring long-term sustainability of this Center.

In addition to the above intended activities, both sides are planning to actively explore options for setting up a joint academic postgraduate program in the area of intelligent transportation systems which may be offered out of the CENTER to Indian, German and other international students.

Article 6: Collaborative Activities

The parties desire to formalize a collaborative relationship to work together towards the scientific goals. It is envisioned that the Parties will develop strategies and share relevant information that will promote and sustain the collaborative efforts. Joint projects are foreseen in all fields of common interest and shall be governed by the following terms:

1) A collaborative project will have its own agreement/contract addressing issues such as intellectual property rights, funding patterns, disclosure of information, liability etc.

2) The approval of any project will be subjected to the availability of funds.

Article 7: Commencement

1) No rights or limitations of rights will arise from the terms of this MoU.

2) This Memorandum of Understanding is non-binding and is intended only to express the intent of the parties to explore possible avenues of collaboration. No liability or obligation of any nature among the parties arises from this MoU.

Munich 19.06.2018

(Place, date)

(Signature Partner)

MÜNCHEN 19. VI. 2018

(Place, date)

(Signature TUM)