CyLOS

CyLOS
Cycling Level Of Service Evaluation Tool

Draft Final Report

Developed by:
SGArchitects, New Delhi
in partnership with
Fazio Engineerware, Chicago
Technical Advisor - TRIPP, IIT Delhi

SGArchitects www.sgarchitects.in

FAZIO ENGINEERWARE

TRIPP

SHAKTI SUSTAINABLE ENERGY FOUNDATION

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Project Overview:

Project Title:	**Comprehensive Cycle Infrastructure Auditing and Design Tool (CyLOS)**
Technical Advisor:	Transport Research Injury Prevention Programme (TRIPP), IIT Delhi
Project Consultants:	SGArchitects, New Delhi.
Project Web tool Developer:	Fazio Engineerware.
Project Sponsor:	Shakti Sustainable Energy Foundation.
Project Duration:	360 days (1 Year).
Project Start Date:	June-15th 2013.

1 Background:

It can be expected that the government's policies for boosting cycle use in the cities would attract investments in street infrastructure improvement along with other measures, increasing the potential of using cycling to combat GHGs in India. To realize the full potential of these efforts, the infrastructure design would need to evolve around a detailed understanding of user requirements as well knowledge to convert this understanding in to an effective design, which would attract the desired use. To make this possible designers, planners, engineers etc., would need to be equipped with relevant toolkits, guidelines and manuals. So far; in the absence of any detailed regional design and evaluation tools, it is estimated that more than 75% of the NMV infrastructure development under JnNURM (and other funded schemes) fails to meet user requirements and expectations and thus attracts negligible or dismal use. Planning and engineering solutions failed to integrate cycling in urban infrastructure; resulting in either over segregation to block motorized two wheelers thus mostly excluding use; or reduced priority resulting in bicycle network being compromised to motorized vehicular parking or lanes.

Recent efforts to produce such guidelines and toolkits include the NMT design guidelines being developed by TRIPP, IIT Delhi. This effort furthers the work on 'Manual for Cycling Inclusive Urban Infrastructure Design' initiated by I-Trans in association with SGArchitects. The manual is being upgraded to a comprehensive NMT Planning and Design Guidelines, with inputs and review from different experts.

This guideline provides an inventory of approaches and solutions for planning and designing of NMT infrastructure in Indian cities. It is felt that this information along with NMT infrastructure audit benchmarks (to be included in the guidelines) can be moulded in to a feature based, user friendly interactive tool, which can accurately predict and/or evaluate the performance of a proposed or existing infrastructure. The outputs from the tool would also include suggestions on designs such as cross section arrangements, intersection details, etc., which will be useful for planners and designers to make informed choices.

2 Need of the Study

This project seeks to develop such a tool to help planners and designers develop an effective Non-motorized transport (NMT) infrastructure, which attracts both choice and captive riders and shall be called CyLOS or short for 'Cycling Level of Service.' The availability of such a tool will direct attention and corrective action towards specific development, implementation and operation issues, resulting in a user appropriate infrastructure. Such efforts in the long term, when replicated across the city, would ensure better utility of investments made in non-motorized transport, generating higher use and better public image. This data would also be useful to CSO's, NGOs, students, academicians and researchers, seeking to quantify the merits and demerits of developed facilities; as well, effect policy level interventions to address identified critical issues, which are beyond the limits of design solutions. These include, funding of projects, capacity building, dis-incentivising private transport use, etc.

3 Goal and Objectives

The final goal of the project is to develop a user friendly cycle infrastructure audit tool which shall provide planners, designers and decision makers; information on infrastructure planning and design shortcomings as well possible improvement strategies for both existing and planned cycle infrastructure. However, this cannot be realized without exploring the tool to its maximum potential. Hence to achieve the stated goal, the tool needs to be disseminated amongst city officials, consultants, practitioners and the user groups, so the primary objectives which can be drawn and needed to be fulfilled are:

1. Creating a comprehensive and user friendly web based tool which can evaluate detailed Cycle infrastructure analysis for all the project cities. This tool would result in development and creation of general set of context specific recommendations for Cycle infrastructure development. Based on various alternative design scenario analyses of the cities the report could be used in toolkits and manuals.

2. Training city officials and consultants to use CyLOS tool in order to develop cycle infrastructure based on a comparative analysis of various alternative designs. The target audience would include state and city level engineers, along with consultants involved in the development of NMT corridors and plans in each city.

3. Enabling the cities to provide the project monitoring and sanctioning committees with a detailed comparative analysis with respective outcomes to evaluate different alternative design scenarios and their implications.

3.1 Scope and Limitations

As the idea of the project is to develop a user friendly tool for auditing cycle infrastructure and design therefore the project is limited only to cycling infrastructure and users including bi and tri cycle users.

4 Literature Study

Evaluation of cycling infrastructure needs to be comprised of various elements and features in terms of cycling requirements. These cycling requirements are categorized under five major categories: Coherence, Directness, Safety, Comfort and Attractiveness.

Coherence – Coherence relates to the legibility and connectivity of the bicycle network. In design, this implies that the segments in the network should look similar to improve the legibility and usability of the bicycle infrastructure and there is provision of good connectivity between all origins and destinations. Constant width ensured through design with adequate widening at turns and rendering the same texture for typical scenarios across the network shall help not only the cyclists to identify with it but also ensure motorists to be cautious at potential locations .Elimination of any missing segments as well as standardization of intersections i.e. the shape, size and form of each category of junction solution should be similar to help the cyclist be aware of vehicular behaviour in the traffic mix. Also, use of various measures like marking, signs and traffic calming measures across intersections improves coherence.

Safety – Relates to safety from accidents and security from crime. Prevention of collisions and reducing the conflicts and their impact shall result in a safer travel. Provision of adequate and uniform lighting ensures enhanced usability as well as safer streets. Integration of spaces for hawkers and vendors, support facilities provides security and the necessary eyes on street. Design of minimal conflicts (and sub-conflicts), introducing traffic calming and resolving complexity by eliminating segregated left turning lanes, etc., makes safer intersection.

Directness – Directness of bicycle infrastructure has to do with the amount of time and effort required by a cyclist to undertake a journey. Therefore, major detours from their natural path should be avoided. As mentioned in **'Design manual for bicycle traffic'** (CROW, June 2007)**,** directness has two components: in terms of distance and time. At intersections, directness in time may be achieved by eliminating stopping/waiting for cyclists by introducing bicycle specific grade separated infrastructure, defining the cyclists right of way and signals which eliminate or reduce staged crossing and delays. Directness in distance for NMV users can be achieved by eliminating any detours or long bends for cyclists at intersections, and by reducing or eliminating stages in a crossing.

Comfort – Relates to physical comfort experience by cyclist, example shade and smooth ride. Riding comfort is essential to bicycle infrastructure therefore the surface should be even and free of cracks and potholes. Riding surface for cyclists at the intersection should be smooth to reduce inconvenience. Water logging in the path of cyclist areas is uncomfortable and therefore it is important that proper drainage should be provided with regular maintenance. Also at intersections, traffic nuisances should be minimum. Segregation terminating up to the

stop line at high speed roads or high volume distributor and access roads will ensure cyclists their Right Of Way (ROW) not obstructed by vehicular traffic.

Attractiveness – Relates to visual and physical attractiveness of the route environment. To ensure attractiveness, it should be taken care that the path of the cyclist should be clean and devoid of any material dumped that blocks movement. Else, it shall prevent the cyclist from using the cycle infrastructure from the initial point and use the carriageway in unsafe conditions. Location of spaces for hawkers and vendors, well integrated bus shelters, green areas, resting spaces, etc. and shaded NMT infrastructure is definitely attractive

The understanding of such features and elements can be consolidated by combing the findings and inferences from the various cycling infrastructure planning and design related guidelines, manuals, thesis etc and for the purpose the following studies presented in the **Table 1** have been followed to develop the CyLOS tool.

Table 1: Literature studies

S.No	Literature Study
1	Urban Road Safety audit (URSA)
2	Public Transport Accessibility Toolkit (PTA)
3	Parisar- Cycle track assessment report - Pune
4	H.C.M based tool developed by Dr. Joseph Fazio
5	Ph.D thesis by J.Himani
6	Bicycle Design Manual for Indian Subcontinent

The chapter focuses on the above mentioned literature reviews undertaken to extract the significant indicators and parameters that can be used for evaluation of cycling infrastructure.

4.1 Evaluation Frame work

For the evaluation of any kind of infrastructure the foremost thing required is to develop an evaluation frame work. This frame work is a methodology to approach the evaluation process. As the prime objective is evaluation, it is observed that each study had a unique evaluation frame work to rate the cycle infrastructure. **Table 2** below presents the objective of the studies and the evaluation frame work adopted for the same.

Table 2: Literature study –Objective and Evaluation Frame work

S.No	Literature Study	Objective	Frame work
1	Urban Road Safety audit (URSA)	Identifying the indicators of safety in urban areas and provide comprehensive solution for urban road safety audit.	Frame work based on the street typology and the context.

2	Public Transport Accessibility Toolkit (PTA)	To define exact parameters, that can be used to describe Public Transport Accessibility.	Frame work based on the street typology and the context.
3	Parisar- Cycle track assessment report - Pune	Evaluation of cycle tracks based on the parameters- Continuality, safety and comfort.	Suggests a feature based evaluation frame work system.
4	H.C.M based tool developed by Dr. Joseph Fazio	To develop a tool for the purpose of evaluation of cycle infrastructure.	Reveals an evaluation network based on type of road and the infrastructure settings.
5	Ph.D thesis by J.Himani	To integrate critical parameters influencing cycling, including land use and street environment aspects.	Focuses on an evaluation frame work based on the user perception and context including road hierarchy and adjacent land use.
6	Bicycle Design Manual for Indian Subcontinent	To develop a cycling friendly manual in context to Indian subcontinent.	Suggests a context and user perception based evaluation frame work system including road hierarchy, adjacent land use and infrastructure settings.

It is observed from the literature reviews, that each frame work for evaluation is based on components which influence cycling requirements. Reviews of above mentioned documents and guidelines have been broken down in the following components which are found to be vital for evaluating cycle infrastructure:

- **Evaluation unit** - This refers to the unit of evaluation such as city, Station area network route or corridor etc.
- **Context** -This refers to the situation or the background of evaluation unit with respect to the surroundings and the conditions on ground.
- **User type** -Indicates type of commuters using the cycle infrastructure.
- **Infrastructure Settings**– this deals with treatment to the NMV users in order to meet cyclist requirements at intersections and mid blocks separately, based on planning and design approaches (in different contexts)
- **Geometrics** - The infrastructure requirements needed to suffice all the needs of NMV users in terms of space and geometrics requirements.
- **Environment and Enforcement** - A good Cycling Environment and Enforcement is required not to force the cyclist with in a cycle infrastructure, but to prevent its misuse by the other modes and functions.
- **Special conditions** – this refers to the site limitations in the form of encroachment, existing trees, culverts, and religious structures, location of bus shelters and insufficient right of way etc. causing obstructions and hindrance in an infrastructure.

4.1.1 Evaluation Unit

For any evaluation to be undertaken, a unit or boundary conditions of the same is needed to be fixed. This is termed as the evaluation unit. An evaluation unit may refer to city, station area network, route or corridor etc as the cycle infrastructure cannot exist or planned in isolation. When city is considered as an evaluation unit, macro level indicators such as accessibility to safe cycling infrastructure, cycling trips as a proportion of total trips in the city, etc. are used. For station area access evaluation, an evaluation of all corridors leading station area need to be conducted. Such an evaluation is broader and may involve aggregation of evaluation for access by all modes including cycling (**Bicycle Design Manual for Indian Subcontinent**). When a corridor or route is desired to be evaluated the evaluation can be conducted for cycling infrastructure independent of the context or in relation to the context. Where the evaluation is independent of context it looks at infrastructure details such as curb heights, widths, segregation type, number of constructions, etc. irrespective of the setting or the road category along which the infrastructure is developed (**Parisar- Cycle track assessment report**). Where a cycling infrastructure is appraised with reference to the context, each of the infrastructure features and performance indicators are evaluated in relation to the context they are placed in. For example the kind of pathway required by cyclist is specific to different road classifications (**Urban Road safety Audit (URSA)** and **Public Transport Accessibility toolkit (PTA)**).

4.1.2 Context

Context forms the base for development of any kind of infrastructure whether it is public transport pedestrian or cycle infrastructure. The design and development of a cycle infrastructure begins by understanding the surrounding context (**Bicycle Design Manual for Indian Subcontinent**). The relationship between the existing built environment and the cycling infrastructure is important to achieve a comprehensive and cohesive cycling package of a city or a street. Therefore, it is essential to identify indicators which can measure and evaluate the context. The features of the surrounding context of an existing or proposed infrastructure are street typology available right of way (ROW), road geometrics, abutting land use, traffic composition on the streets, road cross sections etc(**Urban Road safety Audit (URSA)** and **Public Transport Accessibility toolkit (PTA)**).Context can also vary differently on either side of the road (Left hand side and Right hand side) customized to the street framework, strengthening the need to evaluate the streets separately for both directions.

4.1.3 User Type

The evaluation of an infrastructure largely depends on the type of users using it. This requires understanding the difference between the characteristics and requirements of different non-motorized modes as well understanding the requirements of different types of NMV users. The different NMV modes are further classified into Bicycles, cycle rickshaws for passengers and goods. Cycle rickshaws have different requirements from cyclists as they are much heavier and

require higher effort to maintain a desirable speed and integrate with other modes of transport (**Bicycle Design Manual for Indian Subcontinent**). Hence cycle rickshaws have completely different requirements of access and travel. On the other hand the cyclist can also be further divided into two categories; potential cyclist and captive cyclist. One who bicycles by choice is termed as potential cyclist where as a 'captive cyclist' is bound by economic constraints and do not have a choice. Surrounding land uses and destinations play an important role in determining the type of users of the infrastructure (**Ph. D thesis by J. Himani**) . The proportion of categories of anticipated end-users is important to consider while selecting appropriate bicycle infrastructure and facilities (**H.C.M based tool developed by Dr. Joseph Fazio**).

4.1.4 Infrastructure Settings - Mid block and Intersections

NMV connections consist of a series of road cross sections and intersections. Intersections and mid-blocks play an integral role in providing continuity to the NMV users (**Parisar- Cycle track assessment report – Pune**). Since the issues associated with roads differ from those related to intersections, Evaluation of infrastructure for cyclists require that intersections be evaluated separately from mid blocks segments. This is because intersections require different planning and design approaches (in different contexts) in order to meet cyclist requirements (**Bicycle Design Manual for Indian Subcontinent**).

4.1.5 Geometrics

The infrastructure designed must be such that it suffices all the needs in terms of space and geometry specific to land use and the user type. Different land use characteristics shall result in different geometrics requirements on either side of the road such as width of the cycle tracks, continuity of the tracks, curving radius, height, slope etc (**H.C.M based tool developed by Dr. Joseph Fazio**). The needs of different user types will also result in different geometric design requirements such as slopes and gradients to ease steering at low speeds, good surface type to protect the rider from shocks of the road, segregation type etc. Therefore it is essential to identify the percentage of users using the infrastructure and different components of land uses (**Ph. D thesis by J. Himani**) along the streets and subsequently use the data to evaluate the geometrics (**Urban Road safety Audit (URSA)** and **Public Transport Accessibility toolkit (PTA)**).

4.1.6 Environment and Enforcement

A good environment and strict enforcement strategies are required as motivations for cycling and also ensure that NMV commuters do not switch to other modes of transport. Incompatibility of motorized traffic with NMV commuters is responsible for a significant proportion of the safety issues (**Bicycle Design Manual for Indian Subcontinent**). It is recognized from the literature reviews that if goals to encourage cycling are to be met, then the environment they occur in must be safe & comfortable (**Parisar- Cycle track assessment report – Pune**). Therefore it is important to comprehensively evaluate the host of the cycling

environment such as shade during the day, light after dark, barrier free cycle tracks, traffic calming measures, presence of buffer zone to physically segregate from the motorized traffic, ensuring safety and security for cyclists etc (**Urban Road safety Audit (URSA)** and **Public Transport Accessibility toolkit (PTA)**).

In addition to the environment, establishing effective regulatory and enforcement mechanisms to assist various state and other government bodies to strengthen and improve the cycle riding experience. There exists a vicious cycle between the enforcement issues and NMV commuters. Generally the cycle infrastructure remains unutilized due to the issues like missing lengths, low maintenance, and encroachment by hawkers, parking on cycle paths, etc (**Parisar- Cycle track assessment report – Pune**).Hence for the purpose of evaluation of cycling facilities, the enforcement strategies play a very critical part in the provided or proposed infrastructure. These strategies shall include design and training applications of appropriate safety policies, implement bicycle related laws, speed enforcement for all modes of traffic, prohibition of others modes in NMV infrastructure, implementation of cycling oriented signage and markings etc for enhanced safety of bicycle users (**Bicycle Design Manual for Indian Subcontinent)**.

4.1.7 Special Conditions

Site limitations in the form of encroachment, existing trees, culverts, religious structures, location of bus shelters, insufficient right of way etc presents bottleneck conditions in an infrastructure. These can be termed as special conditions as these can vary according to the route or corridor (evaluation unit), site conditions, relative context, street typology, adjacent land use etc. For evaluation process to be undertaken, these constraints require special attention and design judgment accordingly. However it can be observed that each of the study has taken care of these special conditions according to the features of their respective evaluation framework. Where the evaluation is independent of context, these above mentioned obstructions or bottlenecks form a part of geometry (**Parisar- Cycle track assessment report**).In case of context oriented evaluation the special conditions are been distributed as part of street typology, land use etc (**Urban Road safety Audit (URSA)** and **Public Transport Accessibility toolkit (PTA)**).Similarly if the evaluation network is based on infrastructure settings the site specific constraints are being discussed in terms of intersections and mid blocks located on the existing infrastructure(**Bicycle Design Manual for Indian Subcontinent)**.But to create a better cycling infrastructure the proposed evaluating tool must pursue these special conditions separately as an essential part of input data to rate an infrastructure.

The process for evaluation of cycling infrastructure, adopted in CyLOS tool includes evaluation strategies based on the above findings from the literature studies.

5 Work plan and Methodology

This cycling infrastructure audit and design tool is proposed to be an interactive and user friendly tool with a web based architecture. The evaluation framework of the tool is constructed based on comprehensive stakeholder based reviews gathered from different cities such as Delhi, Ahmadabad, Rajkot, Pune, Nanded, etc, primary surveys and literature reviews.

5.1 Work plan

The CyLOS project is planned to be undertaken in 4 different parts under two stages or phases; tool development and training respectively. As shown in **Figure 1** first 3 parts of the project fall under tool development stage where as the last part comprising of training of the tool and feedback is incorporated in the stage2.

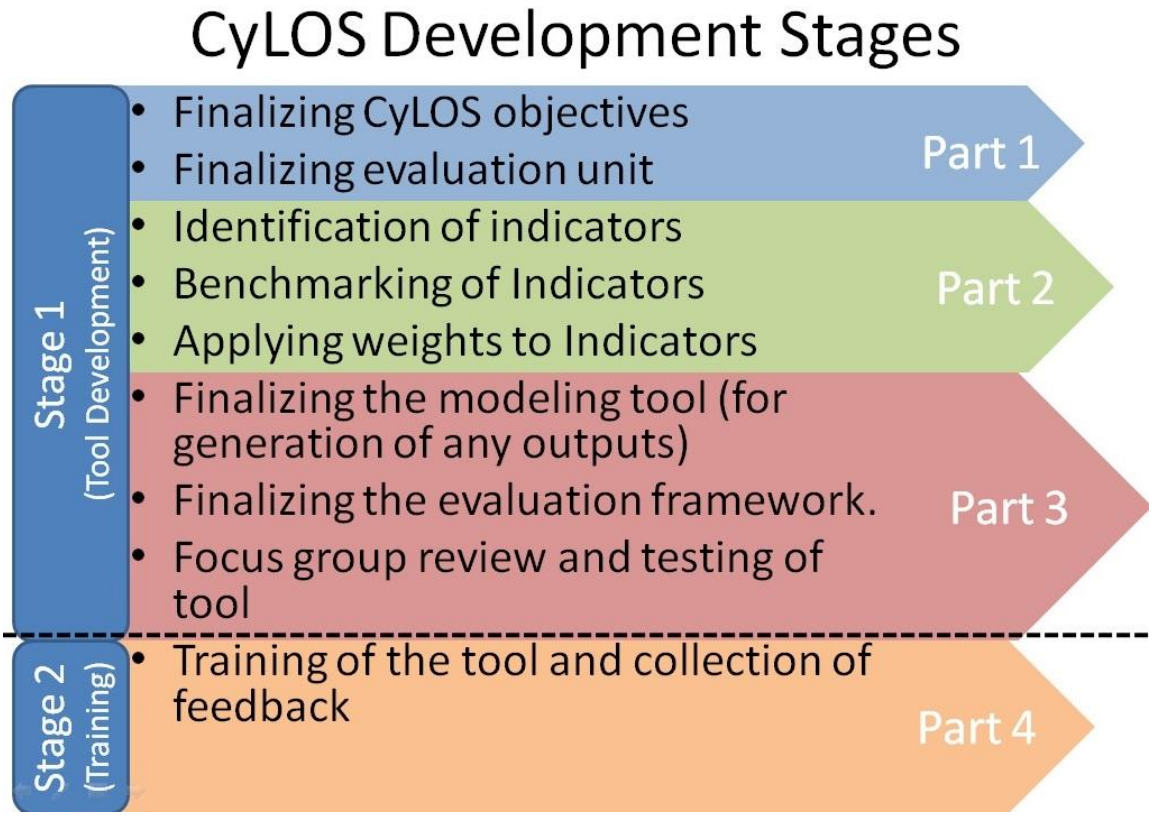


Figure 1: CyLOS development Stages

All the evaluation process and web forms for the CyLOS tool have been designed to be online, to allow collection and inventory of large NMT related data and also to allow a wide spread and easy accessibility of the tool. To achieve this, the tool shall be hosted on its own website, namely www.cylos.in . This website has been activated and initial descriptive pages are uploaded.

5.2 Methodology

CyLOS tool proposes a comprehensive evaluation of cycle infrastructure. The tool devises evaluation of cycle facility in to two major parts, i.e. 'front end' and 'back end'. The front end part of the evaluation incorporates the entire data requirement process while in the back end part, the tool computes and evaluates the cycle facility based on the information provided by the user in the front end part. This methodology is applied throughout evaluation process performed by the tool. Following sections below explain in detail the front-end forms and the back-end evaluation methodology to be used in CyLOS tool.

6 CyLOS Tool – Front End Interface

'Front end' relates to the user interface includes all the control buttons and input forms on the mentioned website. Data is collected through these series of input forms for the evaluation process.

Figure 2 shows the first page, which will be appearing as the user initiates the tool in the web. This page can be termed as the introductory page or the home page comprised of the various link tabs provided at the header or navigation panel of the page. Each of this links provided in the home page of CyLOS tool is being explained in the following sections.

6.1 Web Pages - Links

Before initiating or inserting information, by the user in the front end web forms, the user is presented, a series of additional web pages termed as 'links', which provides description of the tool, team and other information's etc. Given below is a brief description of each of these link web pages.

6.1.1 Home:

This page provides a brief information regarding concept behind creating CyLOS and need of CyLOS tool. The page is comprised with various link buttons, provided at the header part of the page. Through these provided links, the user can gather other important information regarding CyLOS tool. Presently www.cylos.in has the shown **Figure 2** as the main introductory page.

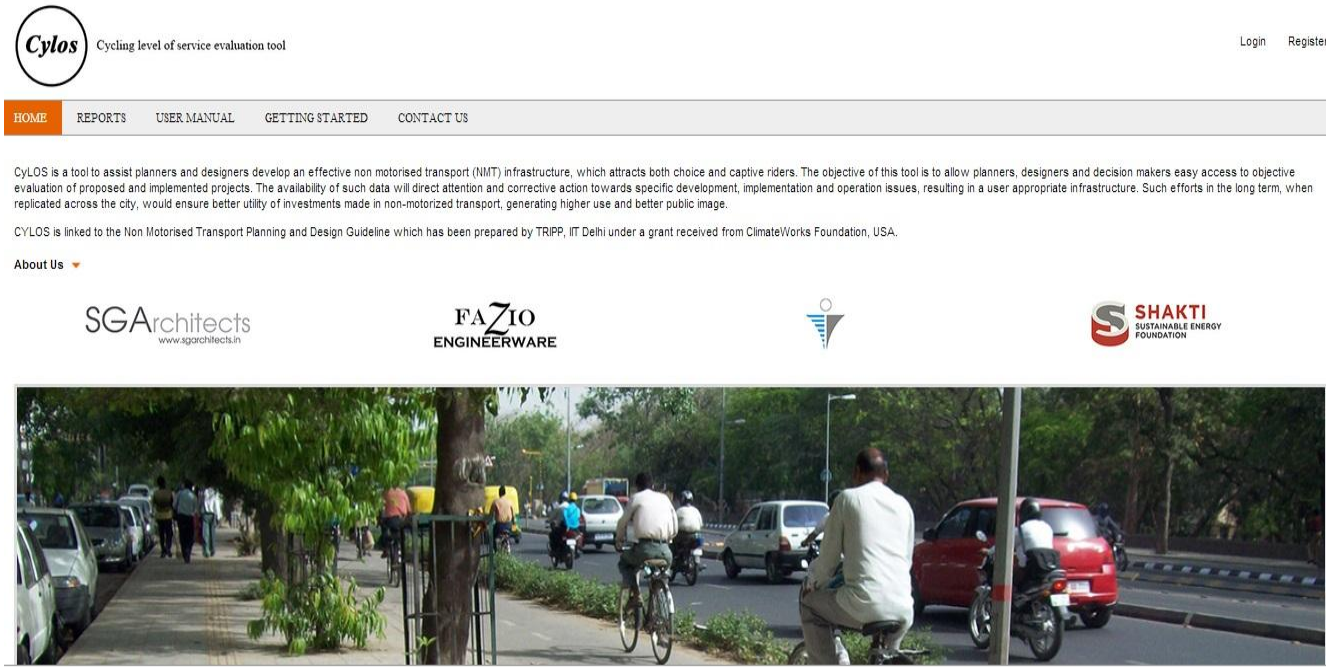


Figure 2: CyLOS Tool Main page or Home page

The home page is also comprised of sub – link 'About us'. This link provide user with the introduction to the agencies and firms, who are being involved in creation of the tool.

Figure 3 shows the description of the 'About us' link.

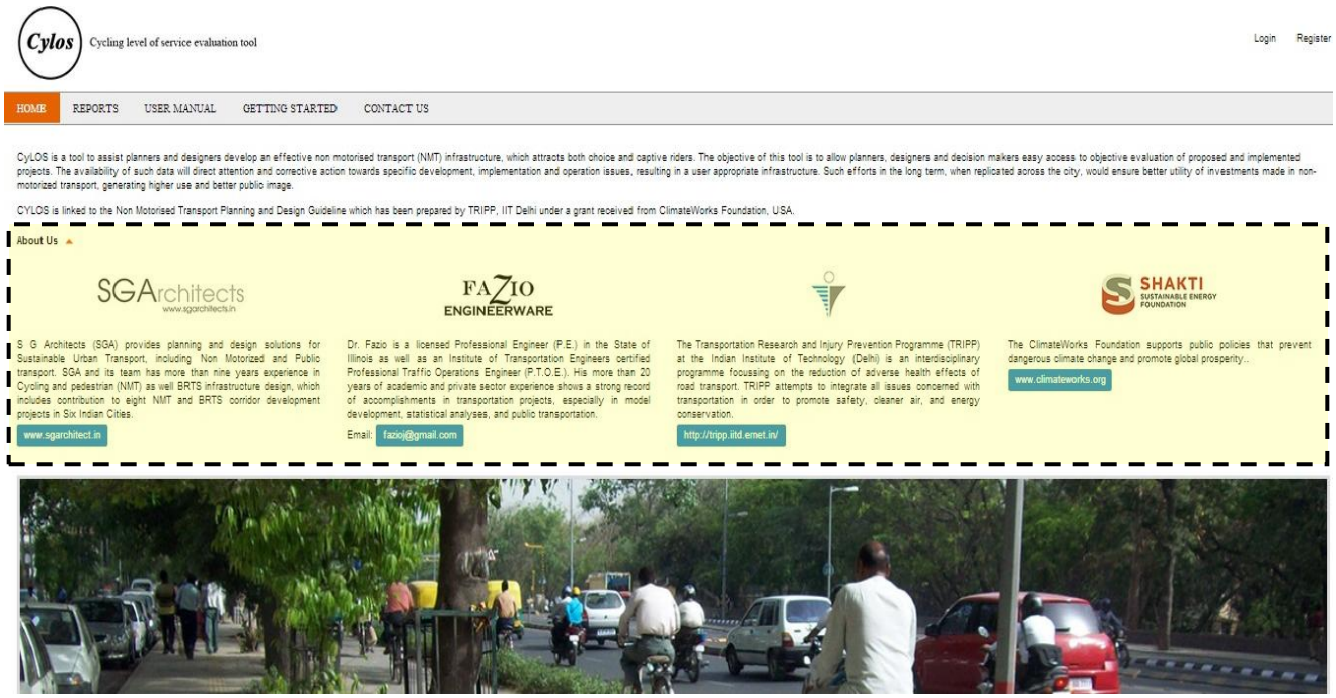


Figure 3: About Us link in CyLOS Home Page

At the right hand side top corner of the home page, options for user login and registration buttons are provided, in case the user wants to switch on to the evaluation part directly without visiting the links provided in the home page. However these option are provided in each of the links pages giving user the flexibility to login or register from any of the links provided in the home page. The details of the user login and registration process are explained in detail later in this chapter.

6.1.2 Reports:

This link will provide user the detailed technical reports prepared for CyLOS tool and Non-motorised transport and design guidelines. User can refer as well as download the reports provided in the link according to his/her conveniences. **Figure 4** shows the 'Reports' link page which will appear as the user clicks on the reports link tab given on the home page.

Figure 4: 'Reports' Link Page

*Note: *Presently www.cylos.in is not updated with any technical report but will be upgraded later with the finalization of tool.*

6.1.3 User Manual:

As the user clicks the 'User-manual' link the page shown in **Figure 5** will appear. This link will have the detailed user manual of CyLOS tool, in case the user may seek any help in using the CyLOS tool.

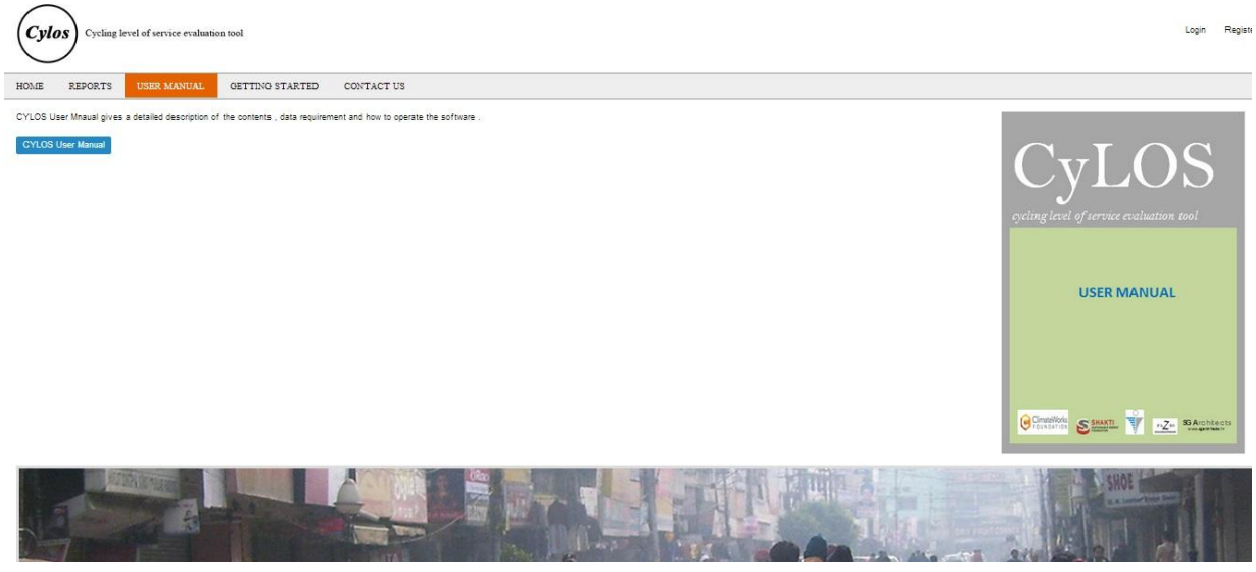


Figure 5: 'User Manual' Link Page

6.1.4 Getting Started:

This link when clicked, will take user to the page, to initiate the evaluation process. The page comprises of a start button namely 'Get started now'. By clicking this button the user can begin the evaluation process. **Figure 6** shows 'Getting started' link page.

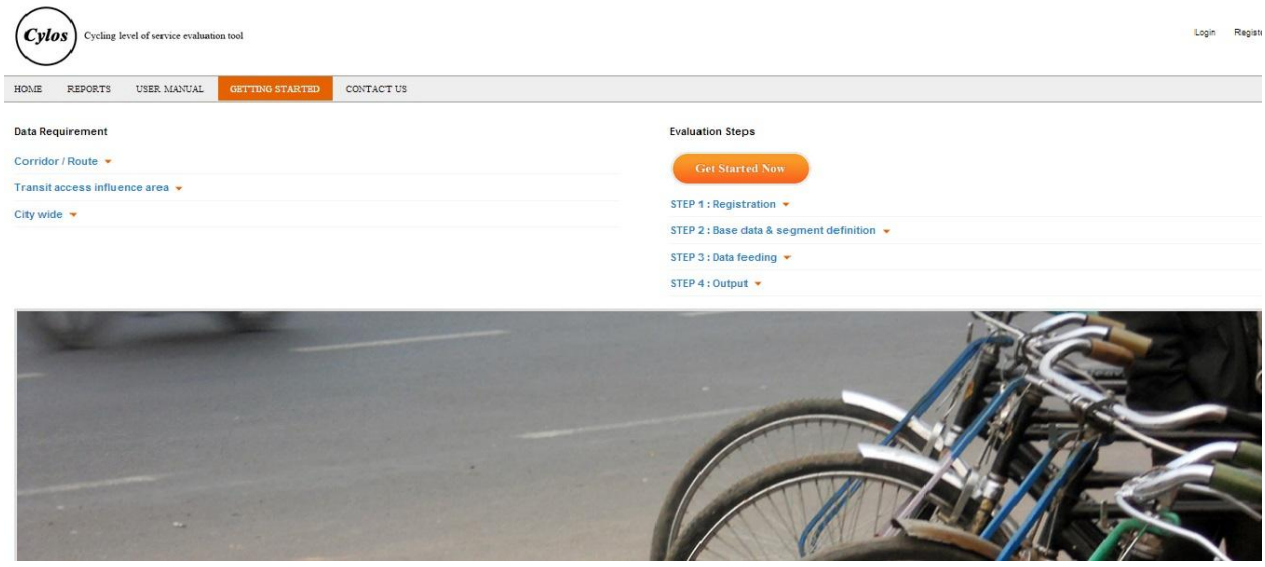


Figure 6: Getting Started page

In addition to this, the page also provides the user set of instructions and things to do before starting any kind of evaluation. As the CyLOS tool evaluates cycle facility under three broad categories i.e. Corridor/route level, transit access influence area level and city wide level, the user may need to collect data accordingly. Hence for the better understanding, user can click on the sub links provided under the Data requirement mentioned in the page on the left hand side and can get a brief primary data requirement list against in each mentioned category. Apart from this, the user can also get information regarding the steps to be followed while performing the evaluation by clicking on the links provided under the evaluation steps shown at right hand side of the page. The links provide user with things to do at the each step while performing the evaluation process. **Figure 7** presents the appearance of the getting started page showing the set of instruction and the primary list of data required by the user under the respective heads, when being clicked on the given sub links explained above.

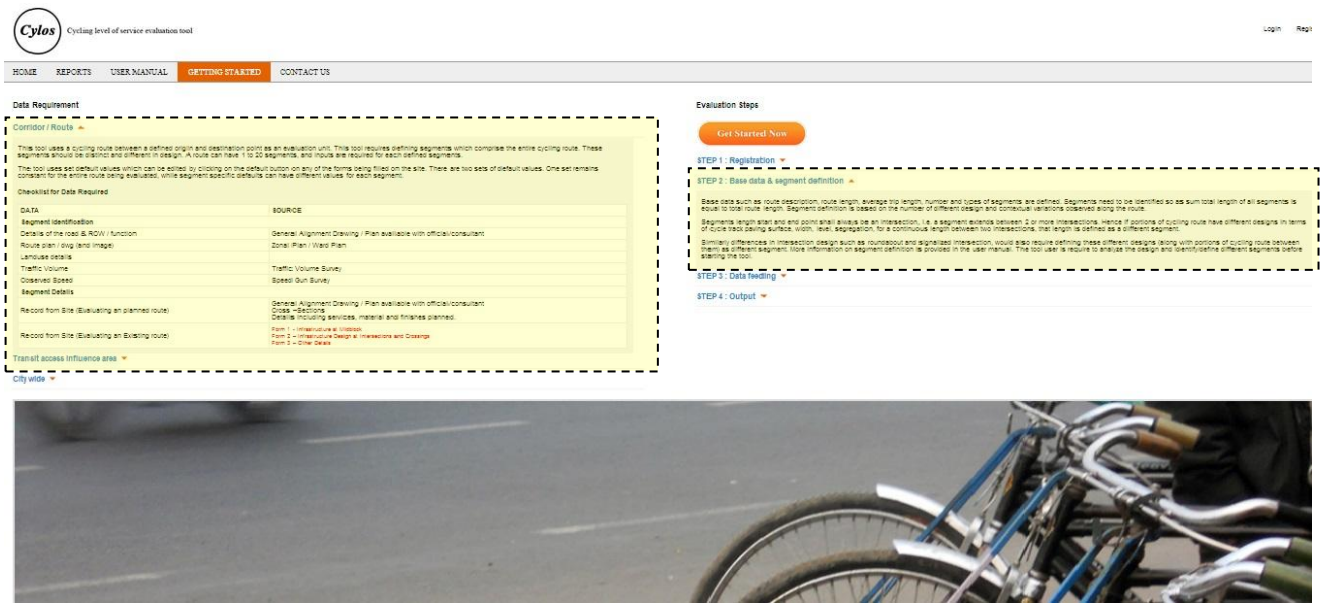


Figure 7: 'Getting Started page' with data requirement list and set of instructions for User

6.1.5 Contact us:

Through 'Contact us' link the user can get information regarding the contact details of the developers (SGArchitects) of the CyLOS tool. The contact detail of the tool developer appears on the left hand side top of the page. **Figure 8** presents the Contact us link page

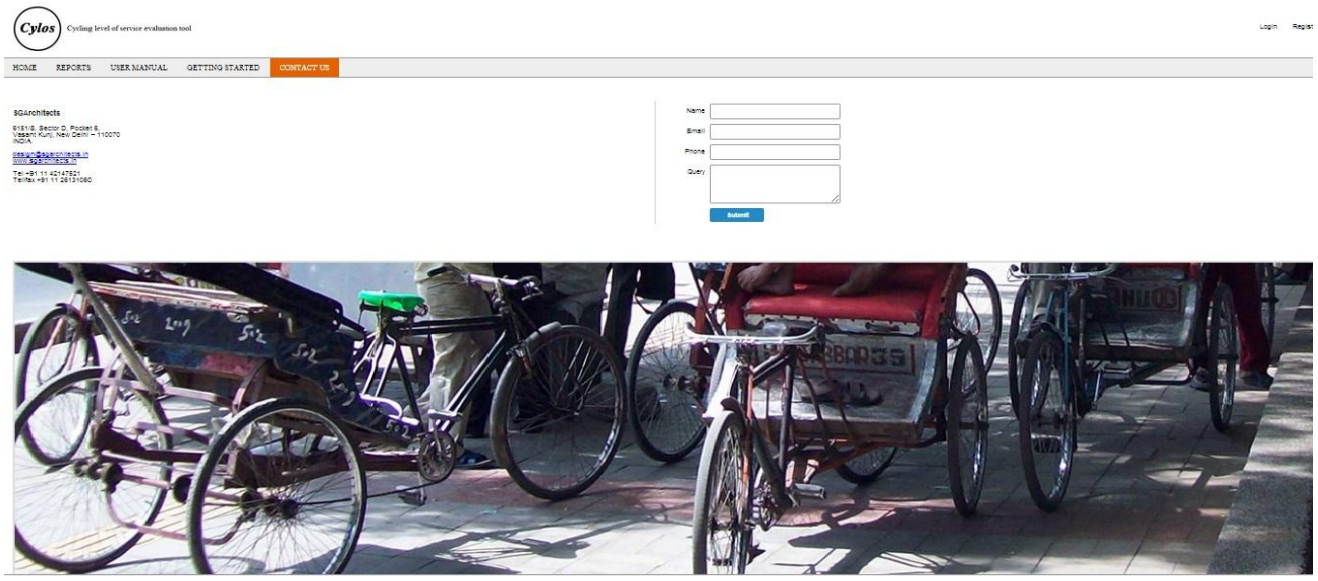


Figure 8: 'Contact us' Page

In case the user may need to clarify any query regarding usage of the tool, the user may insert his/her query with name and web identification, in the input boxes provided the right hand side of the page.

6.2 Web Pages – Login and Registration

As mentioned above sections, each of the link pages is provided with an option for user login and registration buttons provided at the right hand side top corner. As the user clicks the login button, a new web page will appear regarding data input, enquiring the name of the user and the web contact details. This page is termed as 'User Login Page'. **Figure 9** shows the user login page.

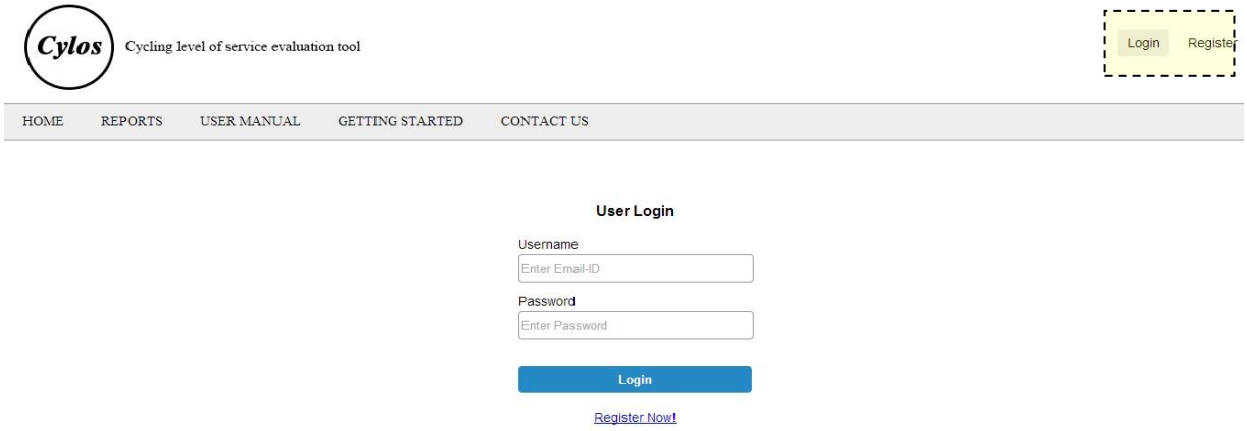


Figure 9: User Login page

The same will appear if the user clicks the getting started button provided in the 'Getting started' link page. **Figure 10** shows the getting started button provided in the 'Getting started 'link page

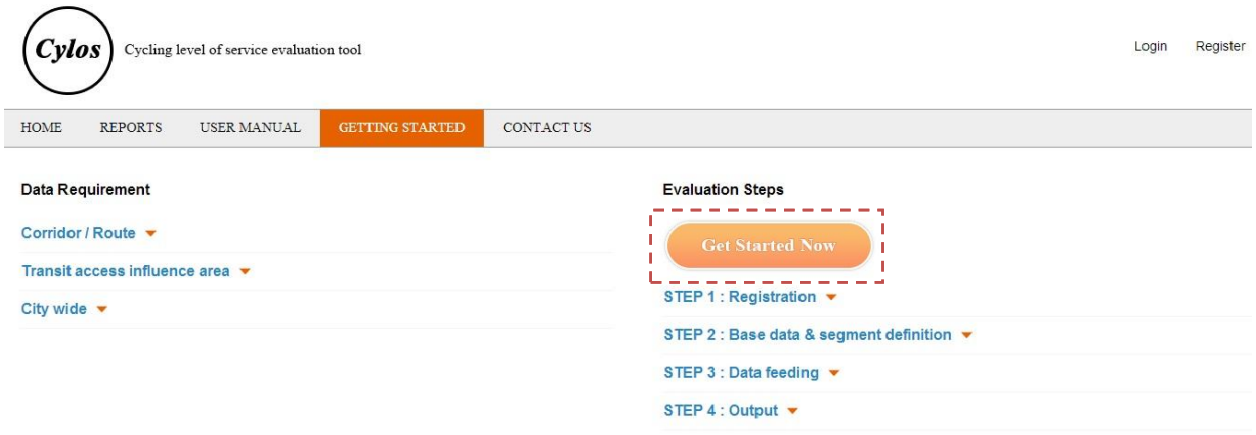


Figure 10: Getting started Button

As shown in **Figure 9**, to initiate the tool, it is required that the user should firstly register in www.cylos.in providing his/ her web credentials and verifications. **Figure 11** shows the registration credentials page required to be filled by user. This page will appear as the user clicks on the register button provided on the web page asking for the details such as name / organization / telephone number etc. After inputting the required information the user should click the submit button given below at the end of the page. This will save the data inserted by the user and will help in creating a resultant registration file which will be used as a CyLOS Contact list and can be used for future operation of the tool.

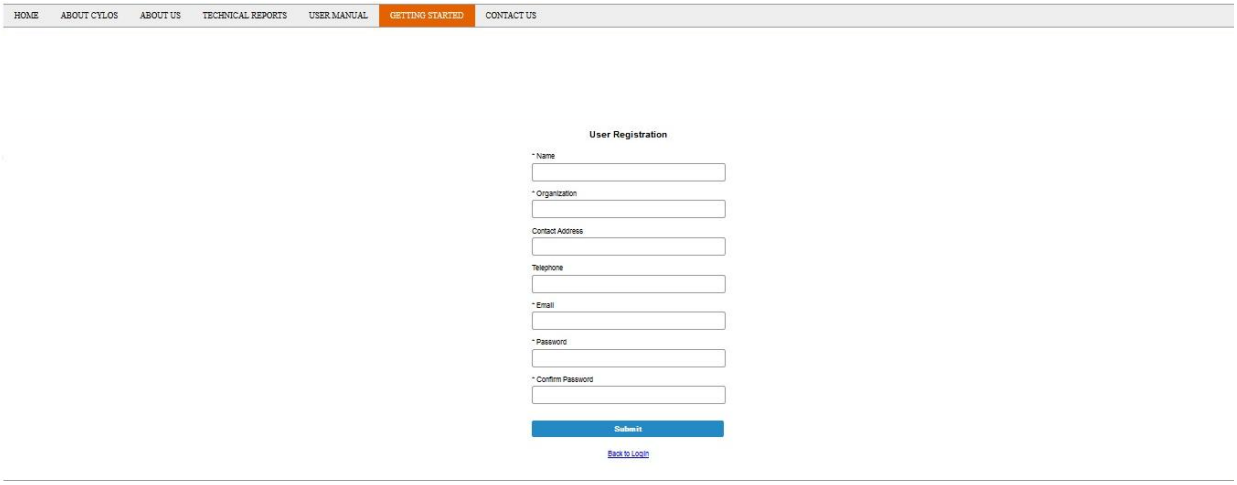


Figure 11: Registration details page

As the registration process is done the tool will give a message regarding successful creation of user profile and the user will be provided with designated password for the tool. Hence with the help of the generated password, user can login or sign in to CyLOS tool and begin evaluation process.

*Note: *For now no password is being designated for the tool as it is in development stage. As the tool gets finalized a password will be fixed and circulated among the tool users based on their respective registration details.*

6.3 Web Pages –Front end Forms

CyLOS tool uses a number of primary forms (generated based on context description) to collect and collate cycling route information. The following sections presents the web-pages designed for the data input in the CyLOS tool required for the evaluation.

6.3.1 Selection of Evaluation type

CyLOS tool proposes to evaluate cycling infrastructure under three broad levels i.e.

1. Cycling Route
2. Transit (or specific function) access network

3. City wide cycling infrastructure availability assessment

Hence after the user login a new web page appears asking user to select the type of evaluation to be done based on the above three broad levels. **Figure 12** presents the page for selection of the evaluation type.

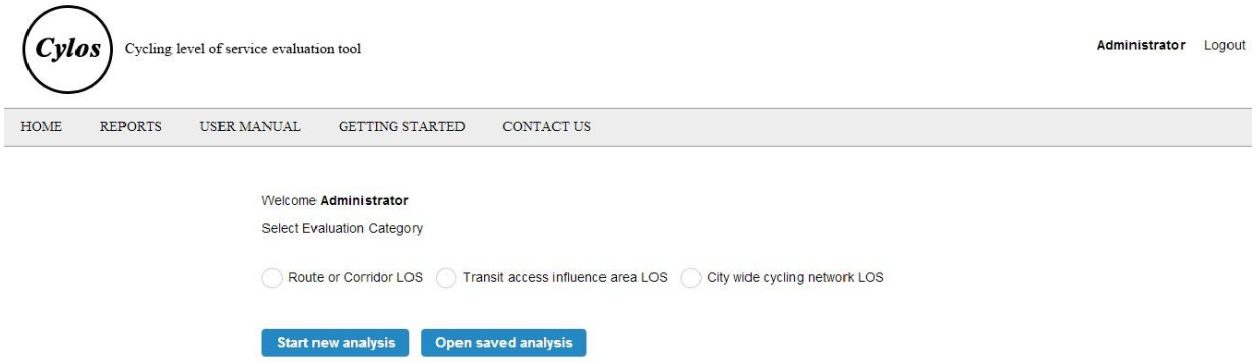


Figure 12: Evaluation Type Form

After selecting the evaluation type, the user has click one of the two buttons provided below in the webpage such that if the user is starting or initiating a new analysis then 'start new analysis button' has to be clicked whereas if the user has already evaluated any cycle facility prior in the tool and wants to review it, then the second option i.e. open saved analysis is to be clicked. Also if the user wants to quit the evaluation then logout option is provided at the right side top corner of the web page. The tool provides the logout option in each of the web forms.

6.3.2 Front-end Data input Methodology:

The objective of the CyLOS tool is to evaluate the cycle infrastructure hence the methodology for evaluation of cycling infrastructure, adopted includes questions integrated, in web based forms (resembling cycling infrastructure audit form presented in **Annexure 10.7**).Further the questions asked in the forms also depends according to the type of evaluation selected by the user, as presented in **Figure 12**. Hence for different evaluation type a different set of front end forms with related questions are being developed.

The user also needs to collate a different set of data for each evaluation type. For the better understanding of user, a primary list of the data to be collected is being induced in the 'Getting started' link against each evaluation type which has been explained in the previous section **6.1.4.** However the user can click the same link provided at header or navigation panel of the webpage and collect the information at any stage of the analysis.

The sections below present the front- end web forms developed according to the evaluation type selected by the user.

6.4 Forms for Corridor/cycling route –Evaluation type

For corridor/cycling route evaluation the questions are being distributed in five broad parts or type of forms. These forms are as follows:

1. Base data form
2. Default form
3. Segment Information form
4. Design and data input form- Distributed in 4 parts these are:
    a) Segment Context form
    b) Midblock form
    c) Intersection and crossings form
    d) Others form
5. Output form.

Each of these forms is related to each other and whole evaluation process in CyLOS tool is based on the data inserted by the user against the questions asked in the forms. Therefore the user has to input data asked in each of the web form accordingly and in case there is any incorrect input or any of the questions remains unfilled by the user, while inputting data than the tool will automatically generate 'Error messages' regarding the wrong input value or missing value on the web form. **Figure 13** shows the error messages in case if incorrect input

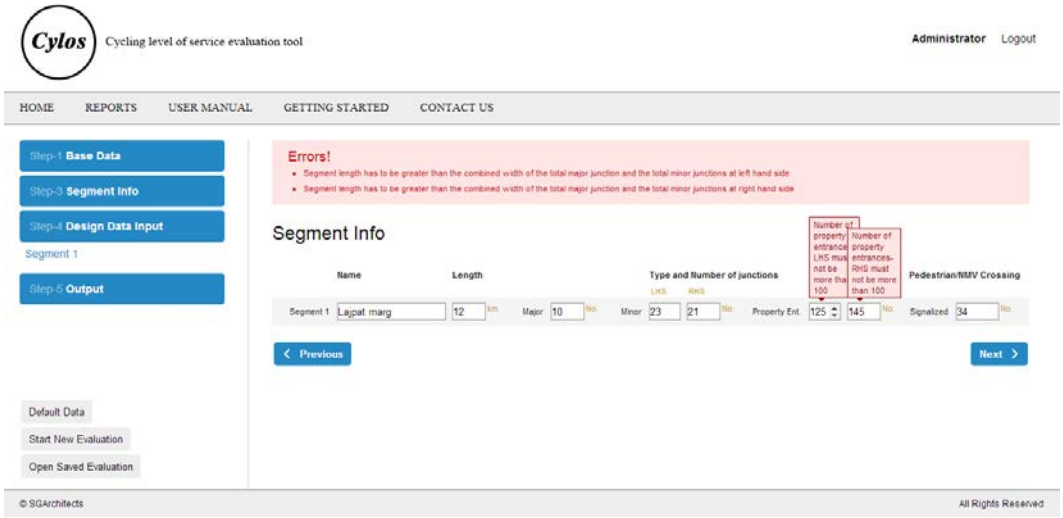


Figure 13: Error messages

These error messages are based on the checks applied to each of questions asked in the forms. Without rectifying the inputs according to the shown error messages, user cannot move forward to the next webpage.

For example: The route length of the corridor should be equivalent to the sum of length of each segment, the corridor is distributed for evaluation. If it is not so in the user input data then the tool will generate the error message for the same against the questions asked on the respective web form.

For proper data input, the user can refer the 'User manual'. To access the user manual the 'User manual link' has to be clicked by the user, provided at the header of the each web page. Each of the questions asked in the user interface forms are designated with coded numbers and detail of each input is being explained according to the assigned number and is been assembled together in the User Manual of the CyLOS tool. **Figure 14** Presents a sample of the user manual.

Note: *The same process of coding is followed for each of the front end form*

Figure 5.1-4 : CYLOS for Corridor / Route – Design Data Input Form 1 – Part 1

1. **Evaluation Type**: Before starting / selecting the appropriate inputs for the infrastructure the user has to select one option out of 'a' or 'b', where,
    a. **Evaluation of an existing infrastructure or facility**: Indicates that the facility/segment being evaluated exists and is operational;
    b. **Evaluation of planned/designed infrastructure or facility**: Indicates a planned or a designed facility/segment which has not yet been constructed or operational.

2. **Street Category and Speed**: The selection chosen will be related to the type of street and design speed of the segment being evaluation i.e. the nature and function of the roadway along this segment. The user has to select only one option out of 'a' to 'f'.
    a. **Independent Track/ Facility**: If cycle infrastructure being evaluated is not along any motorized vehicular road (such as bike ways through parks and motor vehicle free streets) then 'a' should be selected.
    b. **Highway**: If this segment is cycle facility along a highway then 'b' should be selected. Highways are intercity roads with design speeds and speed limits equal to or higher than 70km/h. If a designated highway is passing through the city and used as a city road, it should not be selected as a highway but as one of the lower hierarchy city road as applicable.

Figure 14: User Manual

6.4.1 Corridor Segmentation:

Before initiating the evaluation process and filling the data input forms, the foremost thing that the user has to do is to distribute the selected route/corridor in to desired segments. As the evaluation type selected by the user is corridor/route based, it is essential to consider each and every design variations on the corridor for a proper evaluation. The cycling infrastructure design changes along with various factors like street typology, number and type of junctions, available of Right of way, abutting land use etc. These variations in design features lead to distribution of the corridor/route into different segments. According to the literature studies, the special conditions also influence the design of the cycle infrastructure. These special conditions can be termed as any kind of site limitations in the form of encroachment, existing trees, culverts, religious structures, location of bus shelters, etc hence also needed to be evaluated separately. As every special condition is distinct from one other hence is to be treated as different segment.

While distributing the corridor in to segments, the user has to confirm that the total length of the segments should be equal to the total route length entered in previous input. The segments having similar design features can be grouped together to form a single segment. The minimum segment length can be 40 meters and less than 40 meters in length cannot be considered as segment. Hence considering the above mentioned parameters, number of segments is to be decided and has to be entered as input information wherever required.

6.4.2 Base -Data Form.

'Base-data' form appears as the first front-end form to be filled by the user. To start the evaluation the user has to input basic information related to the corridor such as name of the corridor/route to be evaluated, starting point and terminating point of the corridor, length of the selected corridor/route and the number of segment the corridor is distributed.

Apart from the above mentioned information the user also has to insert an image of the cycle route or corridor, which is to be analysed. This data input can be any image format(jpeg/ png/ gif / bmp or any other image format). **Figure 15** presents the base data web page form.

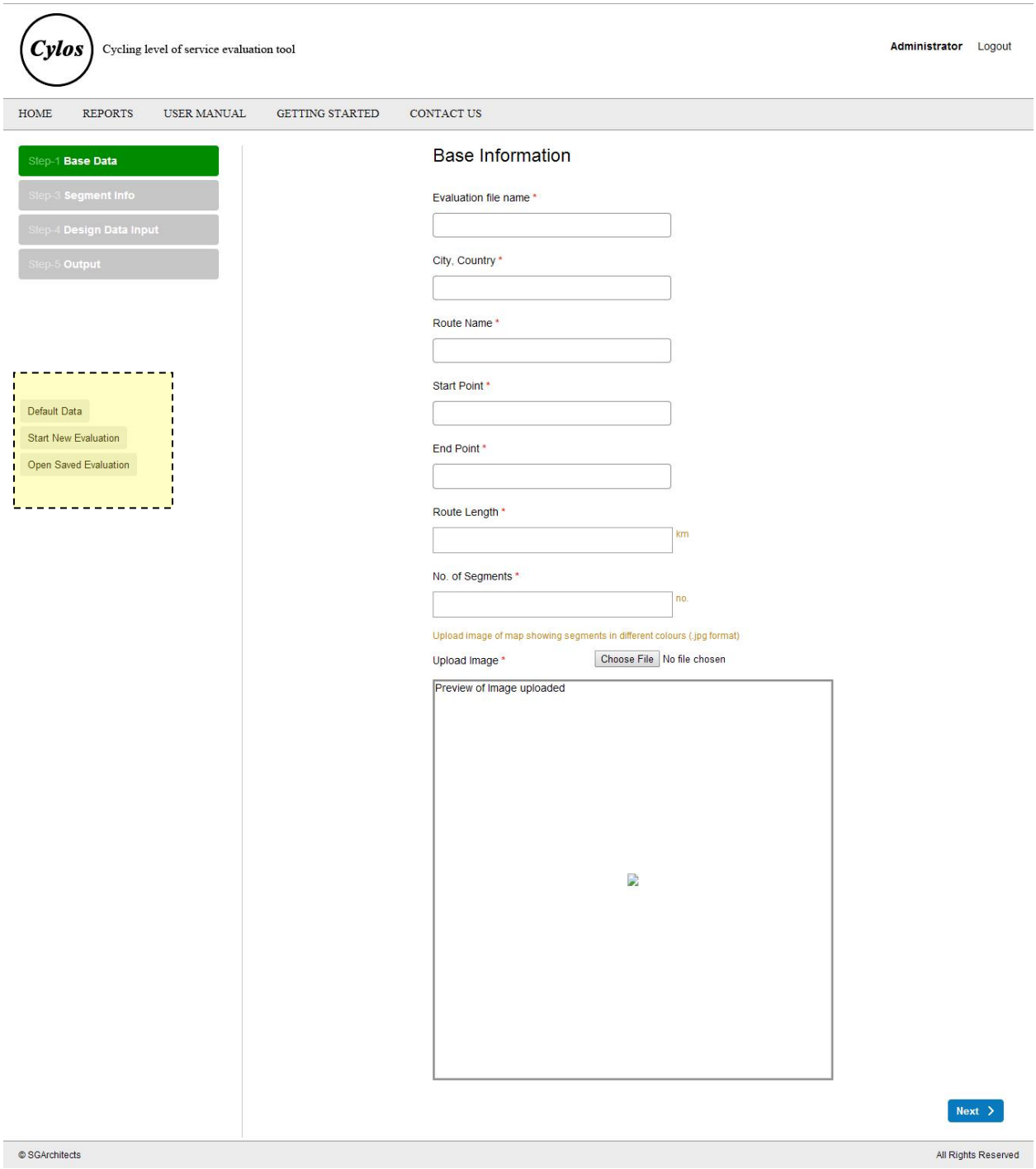


Figure 15: Base data form

It can be observed in **Figure 15**, on the side panel three additional buttons are also provided on. These buttons are:

1. Default Button: As the user clicks on the provided default button, an independent web page form will appear. This form is named as 'Default Form 'and is composed of the default values assumed by the tool which are used in evaluation process. The tool also gives user, flexibility to alter the default values on the default WebPages. The default form is explained in detail in the below section **6.4.3(Default form)**.

2. Starting new evaluation Button: In case the user wants to begin a new evaluation.

3. Open saved evaluation Button: In case user wants to review any evaluation done prior in CyLOS.

*Note: *These buttons are incorporated in each of front-end form.*

The user can move forward to the next web page by clicking the 'Next' arrow button provided at the right hand side bottom corner of the Base data web page. The tool auto saves the data filled by the user as the user moves forward to next web form.

6.4.3 Default Form.

Prior evaluation of any cycle facility or infrastructure, predefined values are assigned in the tool for evaluation. These values are termed as 'Default values' and a separate independent web page form: Default form, is being developed listing all the default values needed in the process of evaluation.

The assigned default values are based on certain standards, conditions and relations derived from the various literature studies, tool kits and researches developed for cycle infrastructure (**Refer**: **Table 1**) . Based on these values, the evaluation of the cycle infrastructure is worked out in CyLOS tool. **Figure 16** presents the default web page.

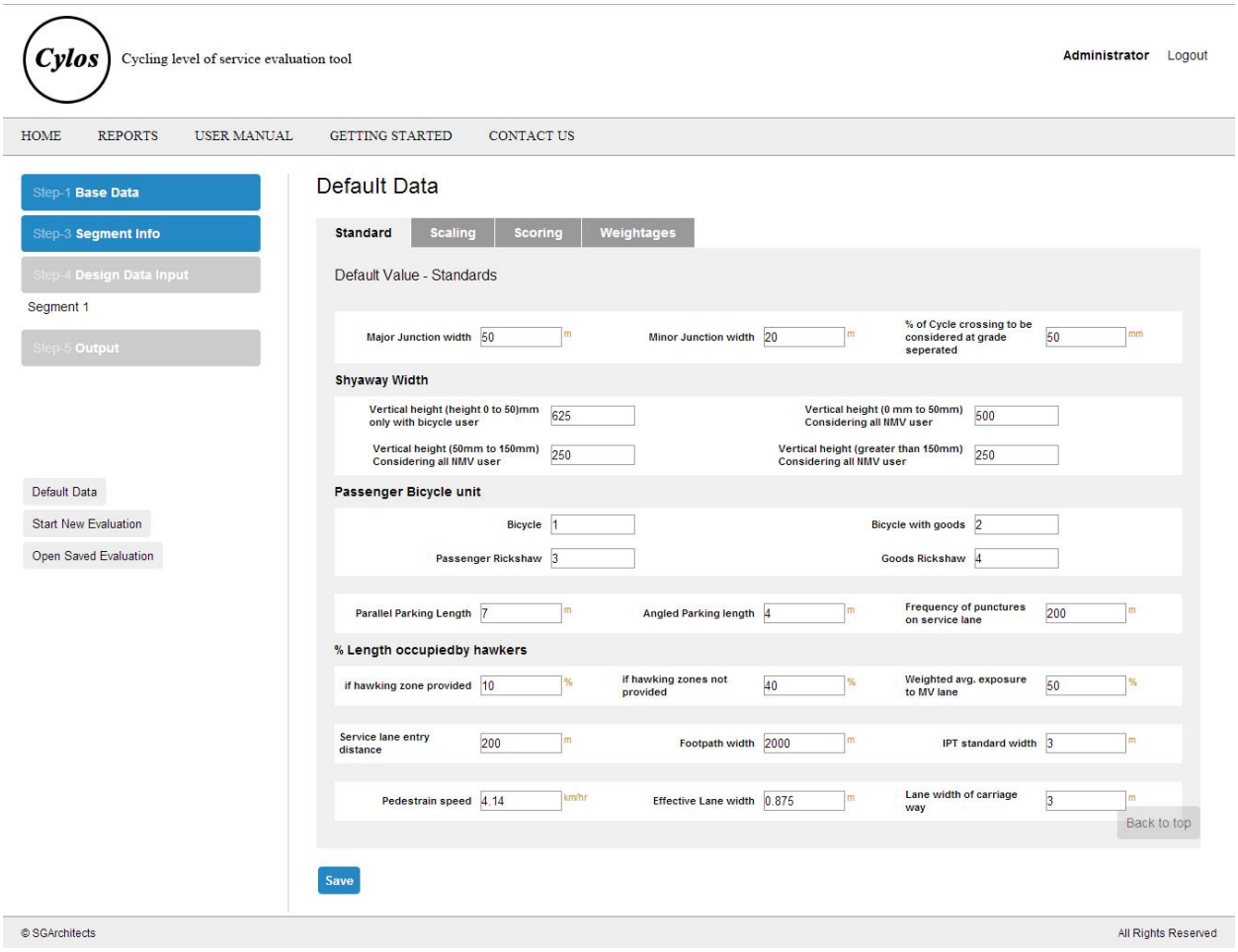


Figure 16: Default data form

The CyLOS tool provides user, the option of altering the Default values but changes to these values are not recommended, unless required for research and academic applications. The new values assigned by the user should be based on detail surveys and authentic sources. These values can also be altered for different context and users as per the location of the route, corridor or the city. It is strongly recommended that the user "Restore Defaults "before proceeding with a new analysis, as values edited in a previous analysis may have been retained by the tool.

As the default values assigned in the tools are of various types such as some are standard values whereas some values are assigned in form of scores, based on the ranges given to the parameters involved in evaluation, some values are multiple condition (matrix) based whereas some default values are the weightages assigned to indicators and parameters. Hence for the better understanding of the user the default form of CyLOS is further divided in four categories which include Standard, Scaling, Scoring and Weightages. Each field according to the respective

category presents the default value of various parameters to be used in the tool for analysis. The 4 different categories shown in Default form web pages are as follows:

a) **Standards**: As the user clicks the 'Standard tab', a webpage will appear showing all the standard default values assigned by the tool. **For example:** Major junction width- 50 meters is considered as the default width for the major junction. The tool gives the flexibility to the user to alter the given default value anywhere between 20meter to 120 meter. **Figure 17** presents the Standard default page.

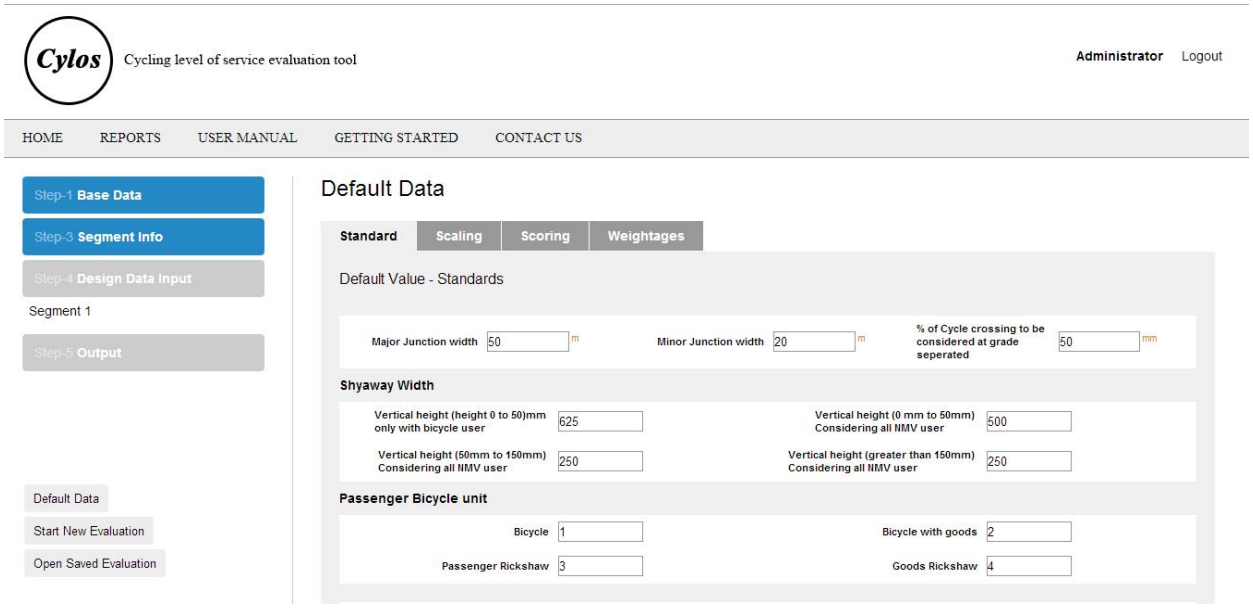


Figure 17: Standard Default data form

b) **Scaling**: As the user clicks the 'Scaling tab', a webpage will appear showing default scores assigned against the ranges decided for parameters involved in evaluation process. The scores are assigned in scale of 0 to 1 depending on the best and worst scenario for each parameter such that the best condition is given the score of 1 and worst condition is given score of 0.

For example: Frequency of punctures: This parameter defines the number of punctures/openings existing along the cycling infrastructure. The lower the distance between the existing punctures higher is negative impact on the cyclist in terms of directness. Therefore, in case, distance between the punctures is less or the punctures are more frequent, the assigned score is given relatively lower based on the range decided for the parameter such as if a puncture exists in every (0 to 25) meters then the

score given is 0 considered as the worst scenario. If punctures exists anywhere from (25 to 75) m, then the score is 0.2. If punctures exists anywhere from (75 to 100) meters, then the score is 0.4. If the punctures exists anywhere from (100 to 150) meters, then the score is 0.6. and If punctures exist anywhere from (150 to 200) meters then the score assigned is 0.8 and If punctures exist at an interval of more than 200m length, which best of the above mentioned condition then the score is given 1 by the tool. **Figure 18** presents the Scaling default page.

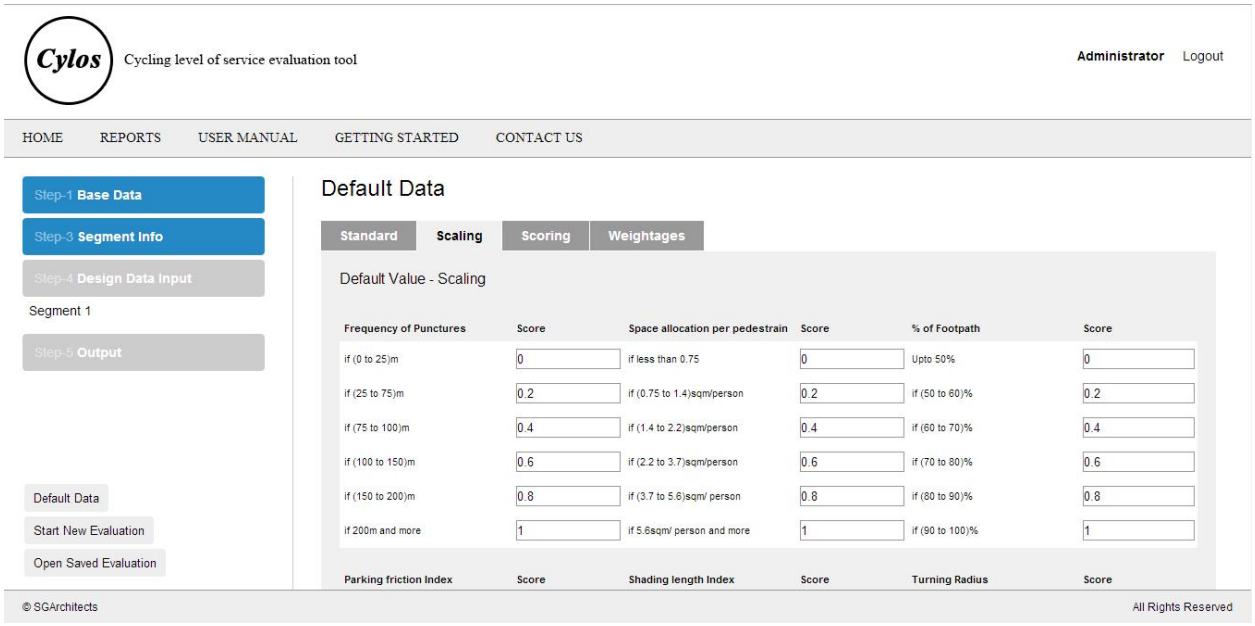


Figure 18: Scaling Default data form

c) **Scoring:** As the user clicks the 'Scoring tab', a webpage will appear showing all the scoring default values assigned by the tool. This particular category is nominated as scoring because Default scores are assigned based on multiple conditions involved hence leading to development of a score matrix.

For example: Based on the cyclist approach to the Intersection relations have been developed and categorized according to the road typology and the cycle infrastructure type. Default scores in a scale of 0 to 1 are assigned to each category and a score matrix is developed based on these different relations such that if cyclist approaches the intersection from segregated track to segregated track on a arterial road then the score assigned is 1 whereas if cyclist approaches the intersection from cycle lane to segregated track on a local road then in case again score given by the tool is 1 and likewise other different relations are being formed and assigned scores.

All the relations are being presented in the default form with the respective scores assigned under different road categories as shown in **Figure 19**

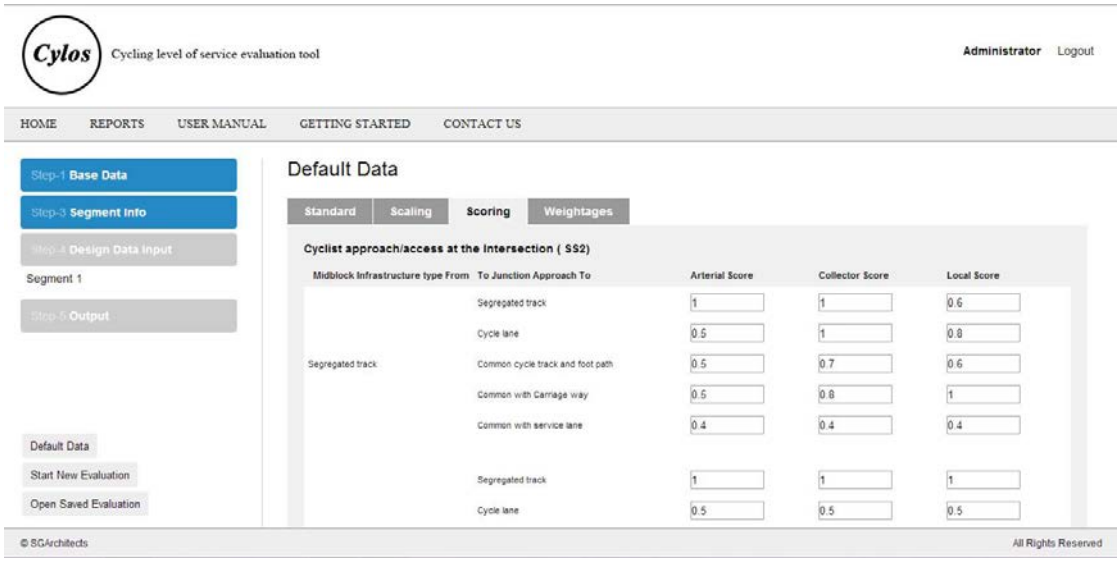


Figure 19: Scoring Default data form

d) **Weightages:** As the user clicks the 'weightages tab', a webpage will appear showing all the default weightages assigned by the tool against the parameters and the identified indicators presents the weightages default page.

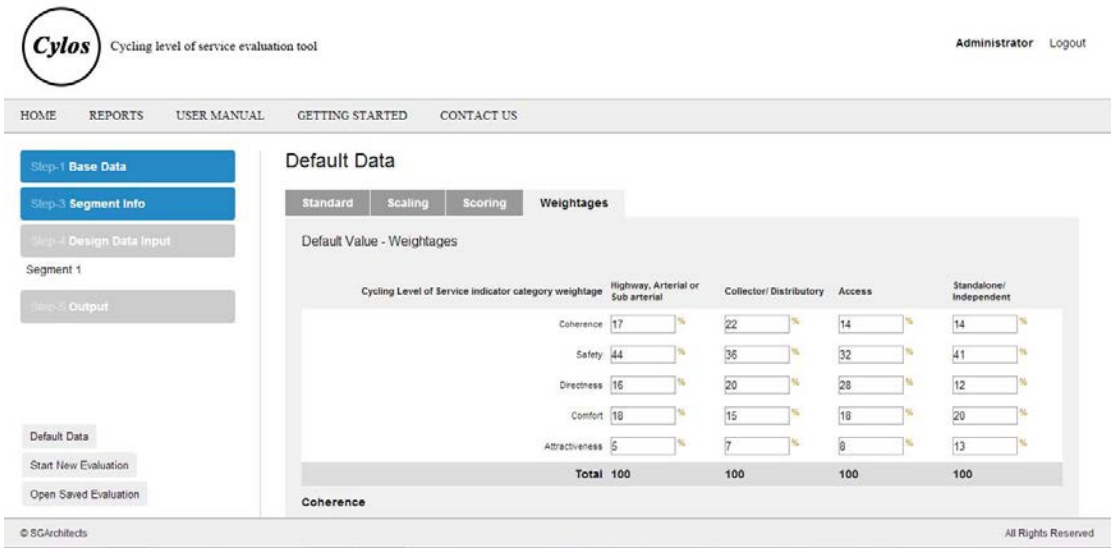


Figure 20: Weightages Default data form

6.4.4 Segment Information Form.

The CyLOS tool proposes separate evaluation for each different segment, and later performance score of each segment will be collated together to evaluate selected corridor. As each of the segments has different design characteristics hence for evaluation process the design detail of each segment needs to be provided by the user. For the purpose the segment information form is developed. **Figure 21** presents Segment Information Form.

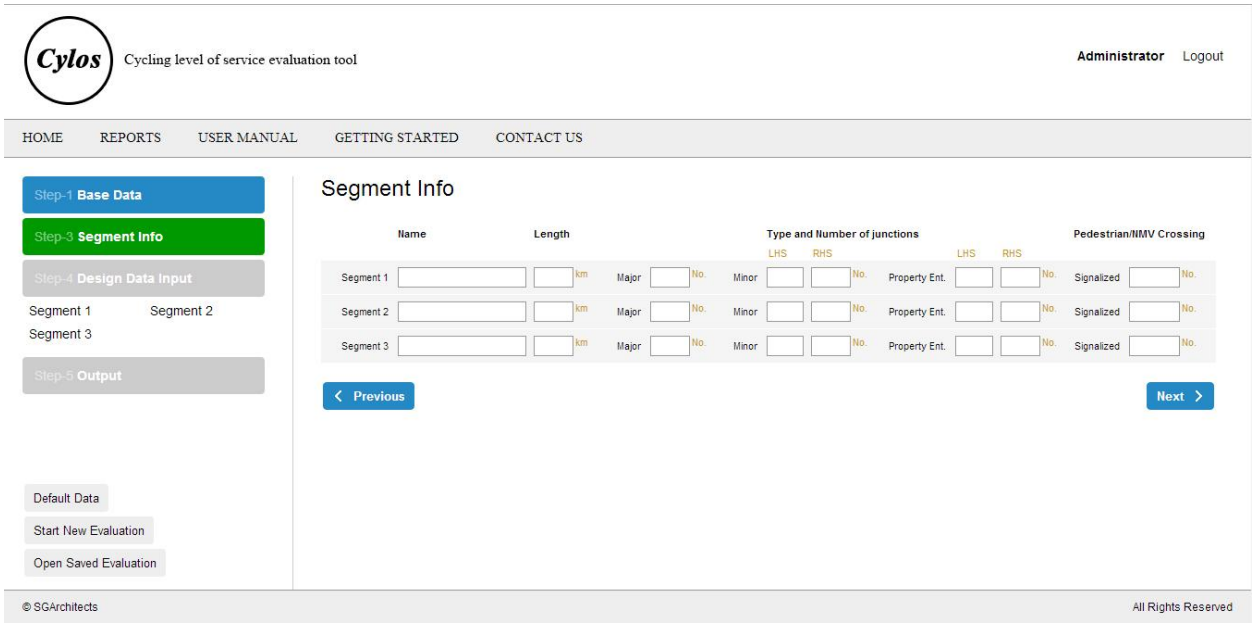


Figure 21: Segment Information data form

Presently the tool permits segmentation of the corridor up to 40 segments but the segment information web-page will display only number of segments inserted in the base data form.

For Example: if user has inserted 3 segments in the base data form then the segment information form will ask to input data for 3 segments only as shown in **Figure 21**

In the segment information form shown in the above, the name of each segment with its length is to be entered by the user. Along with this total number of junctions (major or minor) and number of crossings (safe) are to be induced in this form as the design majorly varies between the junctions and crossings.

Since the base data form and segment Information form, is filled by the user with respect to the whole the corridor or route selected for evaluation, therefore at this stage the other forms also appear on the web page as per the chronological order however these forms are in inactive condition except the 'Default' value form which is an independent form. The same flow is being

incorporated in each of the web form giving user a flexibility to begin, review and exit from the tool as per his/her convienence. As the user clicks the 'next' button provided at the bottom of the webpage the tool auto saves the information inserted by the user and moves forward for the next input web forms.

6.4.5 Design Data input Forms

After inserting the information regarding corridor and segment details in the prior forms, the next step is to collate segment-wise infrastructure design details of the corridor selected for evaluation. For the purpose, design data input form is developed .In this form, user has to input information related to the infrastructure design of the selected corridor/root for the evaluation.

CyLOS tool aims for a comprehensive evaluation of cycle infrastructure, therefore all the design parameters and factors influencing cycling are taken in to account, leading to an inventory of input data, required to be filled by user. But as all input requirements cannot be amalgamated in one single questioner and for the better understanding and ease of the user, the design data input form is further distributed in to four broad categories. The categories are based on the design components which impact cycling requirements i.e. context, midblock, intersections-crossings and others (landscaping, parking, enforcement, maintenance etc).Hence the input requirements with respect to each of the mentioned components are framed as a set of questions in separate web forms. These web-forms are explained in the sections below:

6.4.5.1 Segment Context Form

This part under design input from mainly consists of data input in relation to the context. Factors such as Road hierarchy, traffic volume, land use, foot paths and service lanes, parking etc are to be entered as part of user input. **Figure 22** shows the Segment Context form.

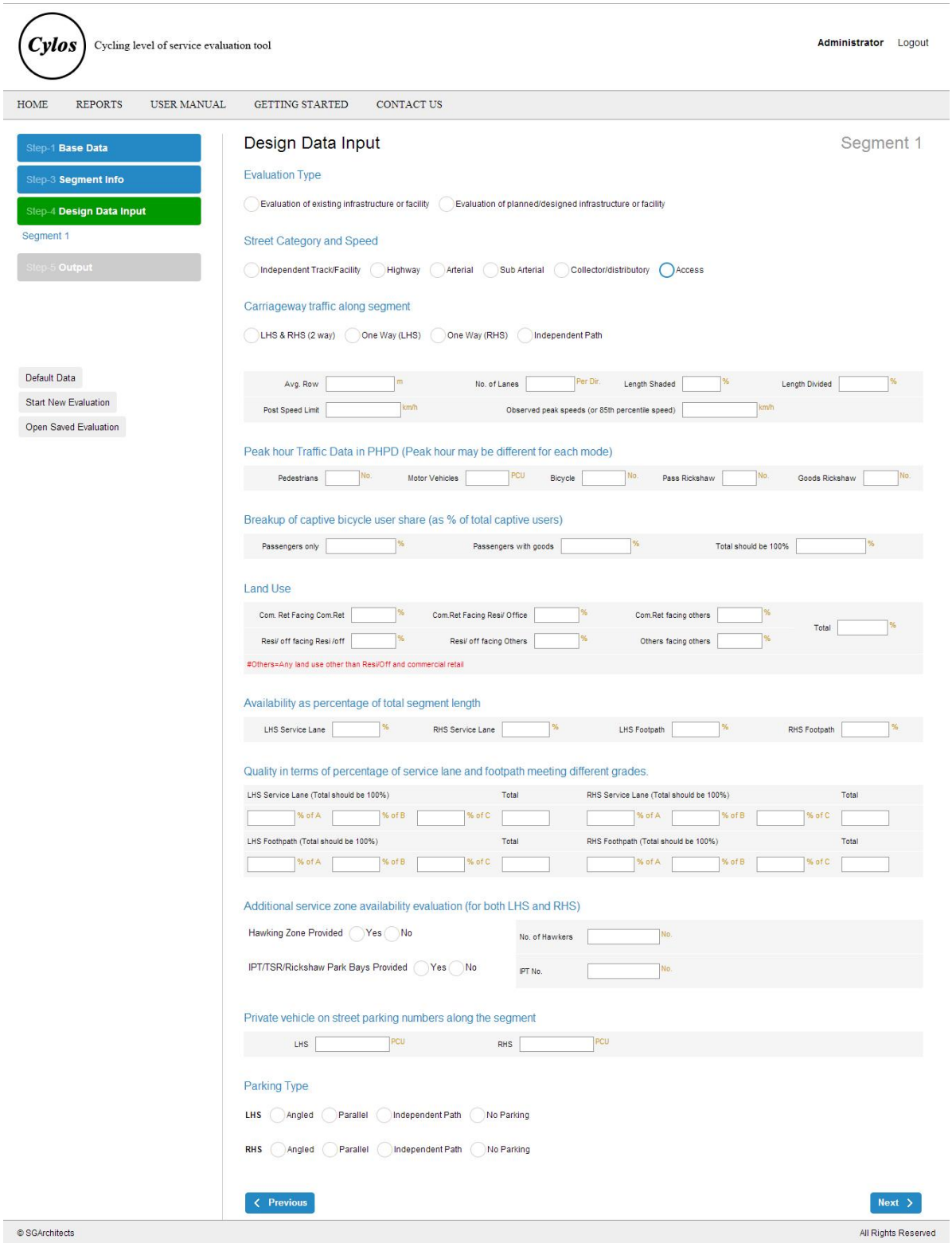


Figure 22: Design data Context form

The segment context form is designed basically under 9 design parameters. These are as follows:

- Evaluation type.
- Street category and speeds.
- Peak hour traffic data.
- Breakup of bicycle user share.
- Land use on the either side of the corridor.
- Availability (foot path and service lane).
- Quality (foot path and service lane).
- Service zone availability.
- Street parking.

Among the above mentioned parameters: street parking, availability and quality of footpath, service lane, service zone which influences the design of cycle facility on the both side of the carriage way are being separately asked for left hand side (LHS) and Right hand side (RHS).

The tools auto-saves the data inserted so far, as the user moves forward to the next web page. The user can move forward for the next form through the 'Next' button provided at bottom right side of the form..Since being the first segment selected for evaluation the button to go back in previous segment is inactive at this stage but will be active for the next segments. The user can move back to the prior web pages in case any alterations are to be done such as changing any default value or updating any information regarding segment in the segment information form by clicking the 'Previous' button provided at the left hand side bottom of the web page. This facility is retained throughout the data input process.

6.4.5.2 Infrastructure Design at Midblock Form

A segment is comprised of two major components: Midblock and Intersections. As CyLOS tool proposes assessment of cycle infrastructure segment-wise, the design details of both this components are required to be provided at the user end for evaluation purpose. But as the infrastructure design requirement for midblock is very different to that of design requirement of intersections. Therefore a separate questioner/web-page form is developed for Infrastructure design at Midblock. **Figure 23** shows Infrastructure design at midblock form.

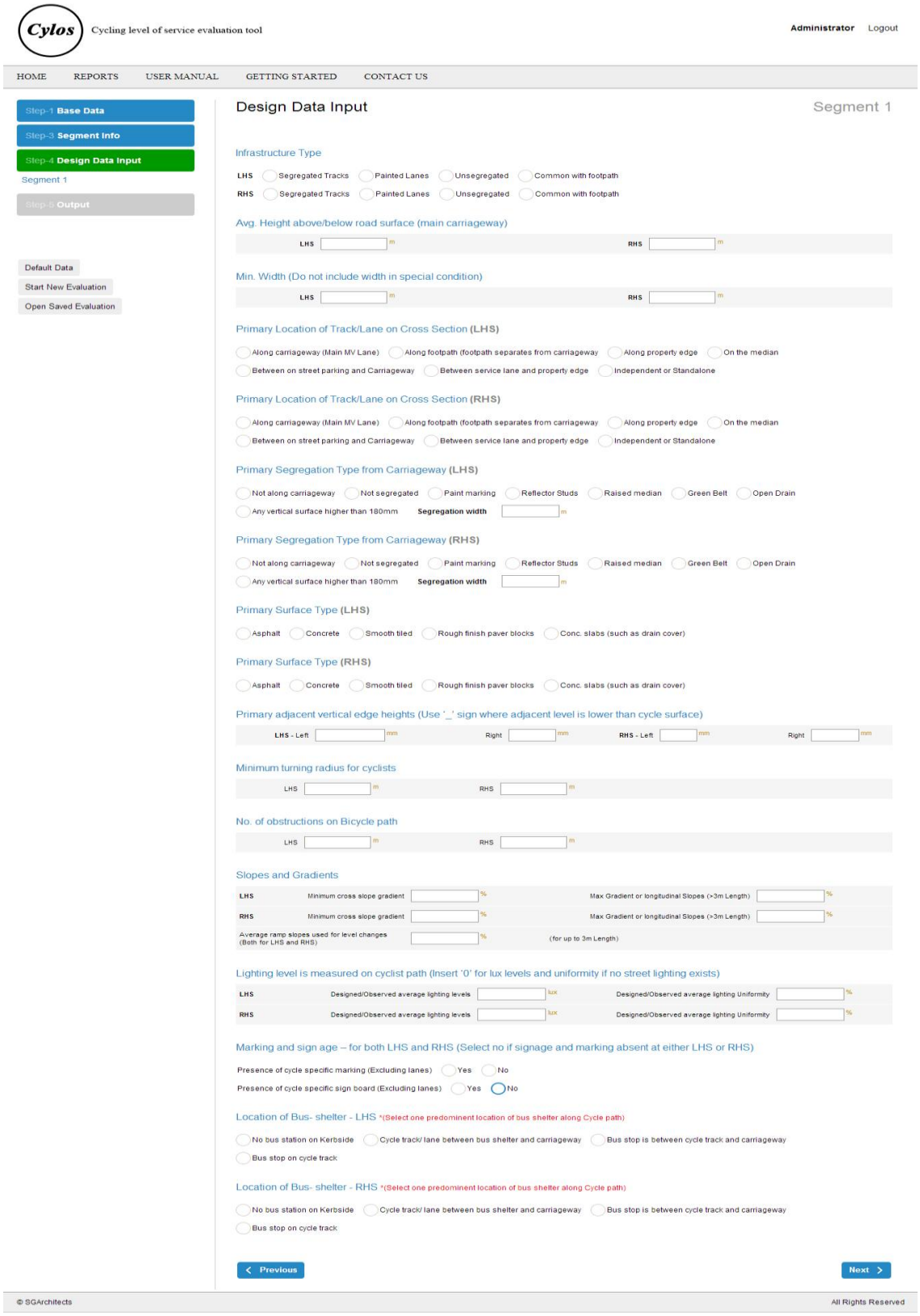


Figure 23: Design data Midblock form

The midblock web form will appear after user fills the previous segment context form. The user needs to input data related to the infrastructure design at the midblock for the selected corridor, according to the designed form format. As the design of the corridor may vary along the either sides of the corridor hence user has to input information seperatly for left hand side (LHS) and Right hand side (RHS) as mentioned in the midblock questioner.

6.4.5.3 Infrastructure Design at Intersection and Crossing Form

Intersections and crossings play a vital role in defining design of corridor/route hence require different set of input data for evaluation. Therefore, separate questioner (Web-form) is designed for the purpose. This form appears after user fills the previous midblock form. The questions listed in the input web page form accounts for all the type of cyclist crossings and intersections and the user needs to insert input data as per the designed form format. For better understanding of the user, the form is distributed as per the intersection typology and the questions related to each type of intersections are grouped under the below mentioned sections:

- **Major intersections**: Data input regarding major intersections is to be filled by the user.
- **Minor intersections**: Data input regarding minor intersections is to be filled by the user.
- **Cyclist crossings other than intersections:** Data input regarding provisions of cyclist crossing (at grade/ signalized) existing at midblock is to be provided by the user.
- **Property entrances**: User has to input information regarding the property entrances.
- **Grade separated cyclist crossings**: Data input regarding provisions of cyclist crossing (Grade separated) is to be provided by the user.

After filling up the form the user has to follow the same set of instructions followed in the previous forms to move forward to the next web form. **Figure 24** presents Infrastructure design at Intersection and crossings form.

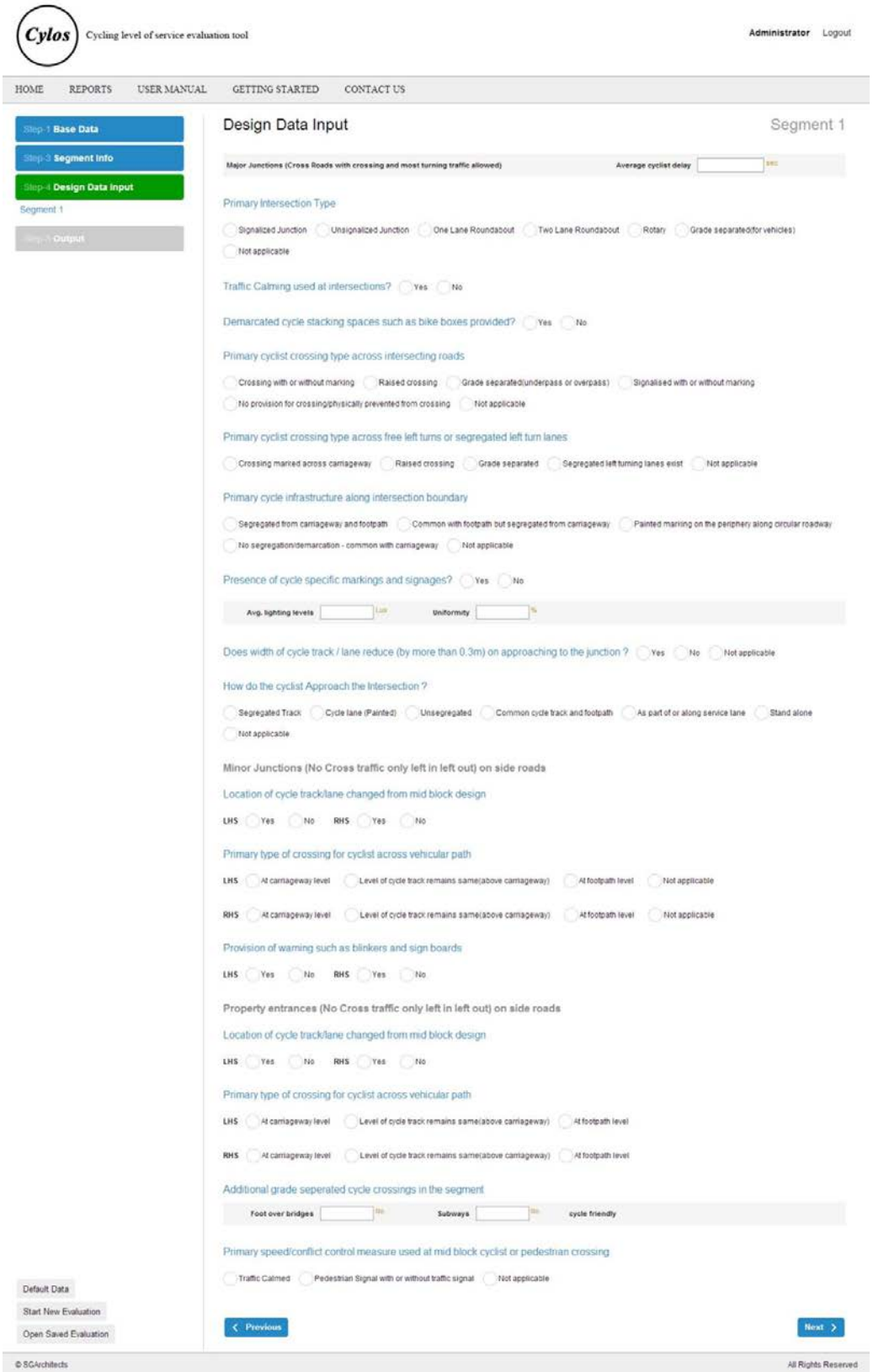


Figure 24: Design data Intersection and crossing form

6.4.5.4 Design Data Input Form - Miscellaneous

Along with context, midblock, intersections and crossings some other parameters such as maintenance, enforcement, landscaping, parking etc also influences the design and play a critical role in the assessment of the infrastructure. Hence in order to evaluate the infrastructure based on these mentioned factors, a separate questioner (web form): Miscellaneous is prepared. This form is proposed to be the last form under design data input and front end forms. Hence the Front-end user input forms conclude as the user fills this web form. **Figure 25** presents the Design data Input form 'Miscellaneous'.

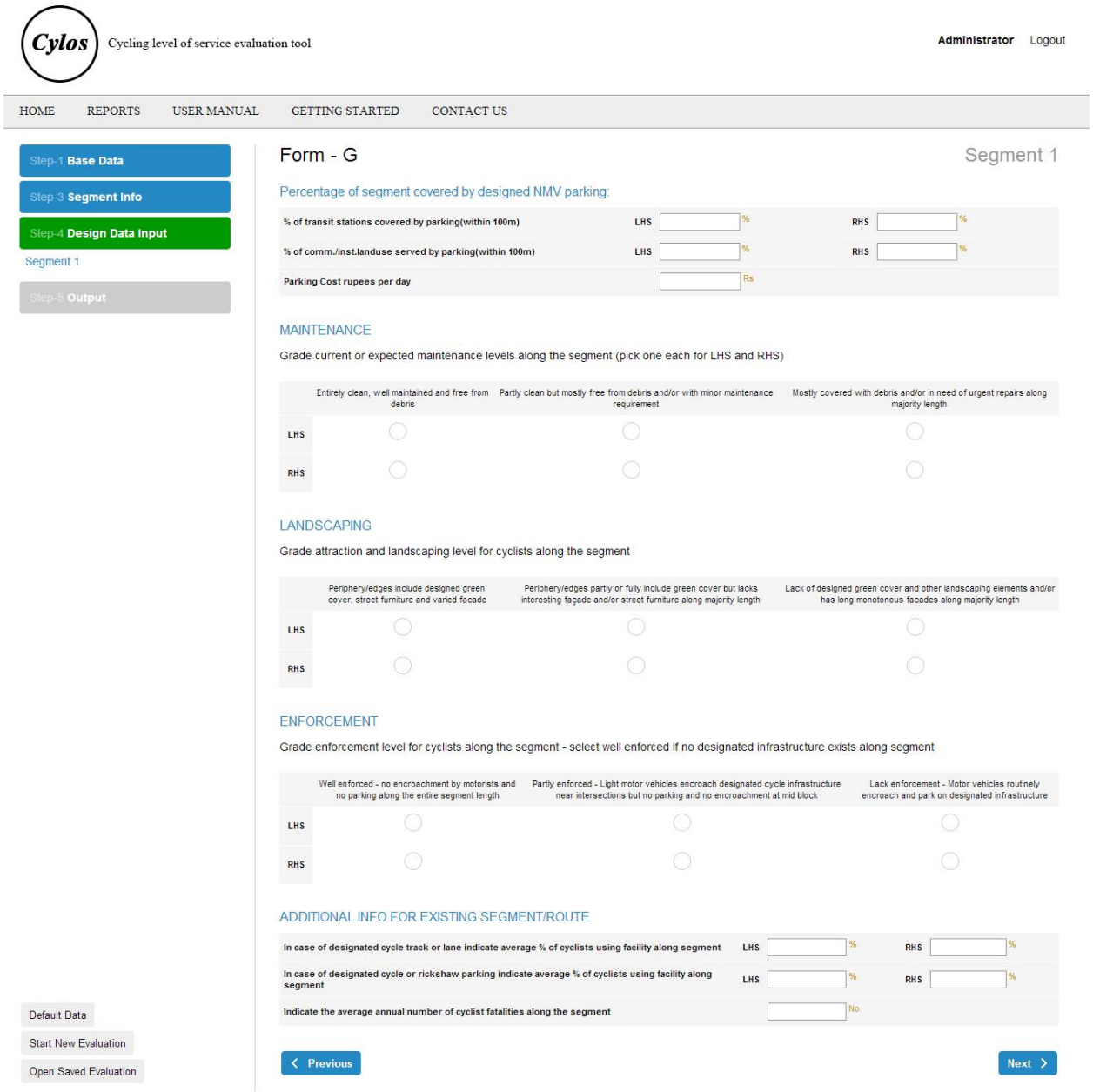


Figure 25: Design data – Miscellaneous form

6.4.6 Segment evaluation result Form – Segment Output Form

After the data input process is complete and all the forms have been completed for a particular segment, a Results page is generated by the tool, specific to the selected segment. This result page can also be termed as 'Segment Output sheet'. The Results page provides user, a performance score of the selected segment. Further based on this performance score, the level of service of the segment is determined which is provided at end of the segment output sheet. **Figure 26** presents the Segment Evaluation result form.

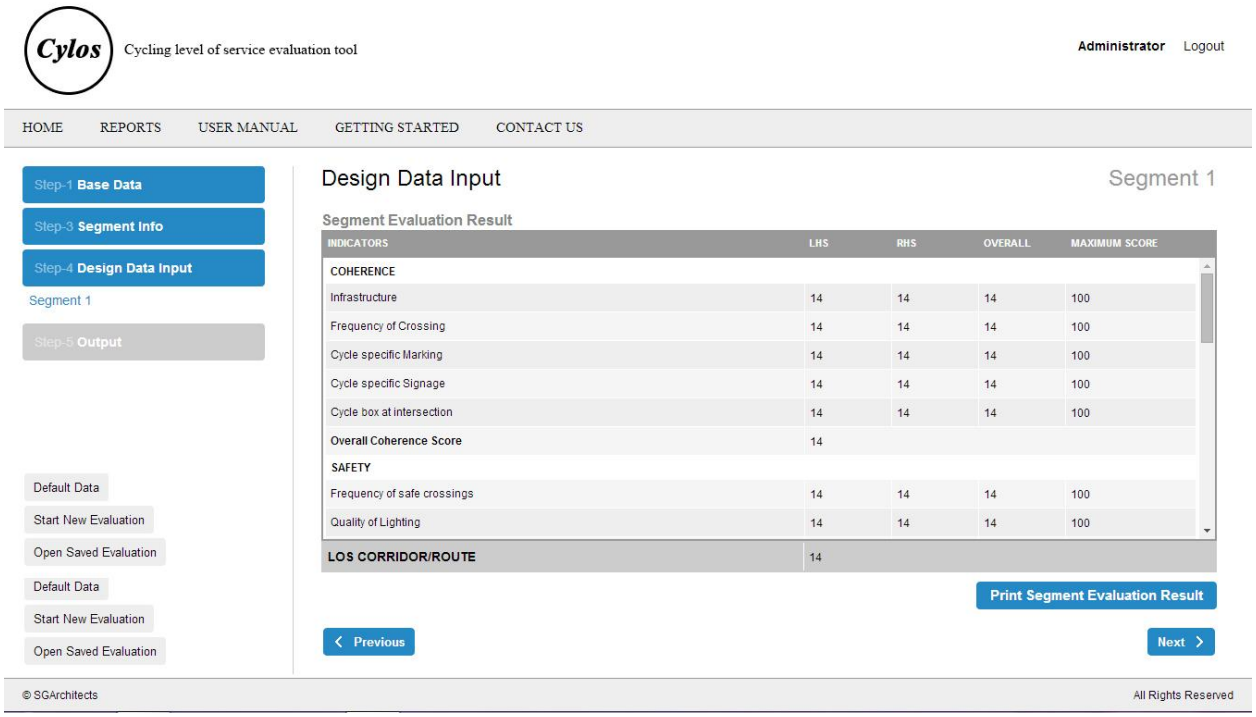


Figure 26: Segment output form

Performance Score – The performance score is the total score earned by the segment after getting evaluated by the tool. This performance score is formulated in the back-end calculations devised by the tool. The segment evaluation is judged or rated on the basis of this performance score earned by the segment, on a scale of 0 to 100 such that the segment earning high score depicts good performance and in case, low score is gained by the segment than the performance is rated to be poor.

The output sheet presents the performance score of the segment in three broad levels. These are:

1. **Indicator level performance** - The assessment of the cycle facility for the selected segment is carried out on the basis of 26 selected indicators influencing cycling requirements. These indicators are derived from the multiple sub-indicators developed

from the input data provided by the user in the input forms. Each of these indicators is assigned with default weightages assigned by tool and as these weightages are being applied to their respective indicators; the output sheet generates performance score for the segment against each of these involved indicators. The user can go to the weightages tab provided in the default form and can alter the assigned weightages as per his/her needs.

2. **Overall level performance** CyLOS tool evaluates selected segment against each indicators separately for both sides i.e. left hand side as well as on the right hand side. The weighted average value based on the default weightages assigned to the each side, produces an overall performance score for each indicator in the segment. Presently each side is assigned with 50% weightages in the tool, the user can go to default weightages tab and can edit the weightages assigned according to his/her convenience.

3. **Category level performance** - According to the literature studies and researches, the cycling requirements are divided in to five major categories. These categories are: Coherence, comfort, Safety, Directness and Attractiveness, also termed as the basic principles of cycling. All the indicators involved in the process of evaluation is directly related to one or other of these mentioned categories and hence the CyLOS tool collates the indicators belonging to similar category and generates a category level performance for the segment. Hence the user can judge the performance of the selected segment of the corridor according to each category.

Segment: Level of Service – Each of the categories: Coherence, comfort, Safety, Directness and Attractiveness are also assigned with individual default weightages in the tool, which can be altered as per user requirement. Further in the back-end computation of the output form, these category weightages, when applied to the corresponding category level performance scores and combined together generates a level of service (LOS) for the selected segment. The obtained level of service for the segment is rated on a scale of 0 to 100, such that higher the score obtained signifies higher level of service and vice versa . The level of service is shown at end of the segment evaluation result form/segment output sheet.

Thus the data input process and evaluation for a single segment concludes with this segment evaluation result form. The user can take a print of the segment output sheet by clicking the print button provided at right hand side bottom corner of the output web-form. The user can also go back to the previous forms by clicking the previous button provided on the left hand side bottom corner. The tool also gives flexibility to the user to move backward to any of the previous forms as at this stage of the evaluation, all the previous forms are active and auto saved by the tool.

Corridor: Level of Service – As soon as the evaluation of the selected segment is completed, the tool will present, same set of data input web- forms for a new segment .The same process of filling the input forms, has to be repeated by user (as explained in the above sections) for the new segment to be evaluated. This cycle will continue till the last segment is evaluated, which is based on the number of segments inserted by the user in the base data form.

After the user is done with evaluation of all the segments, the tool will generate an output/resultant web form, presenting the level of service for the whole route/corridor. The level of service for the whole route/ corridor is based on the individual level of service earned for each segment, length of each individual segment and the total route length provided by the user in the base data form, which is computed by the tool in the back end forms. Therefore the evaluation process concludes with this corridor/route evaluation result form. **Figure 27** presents the output resultant form for the corridor.

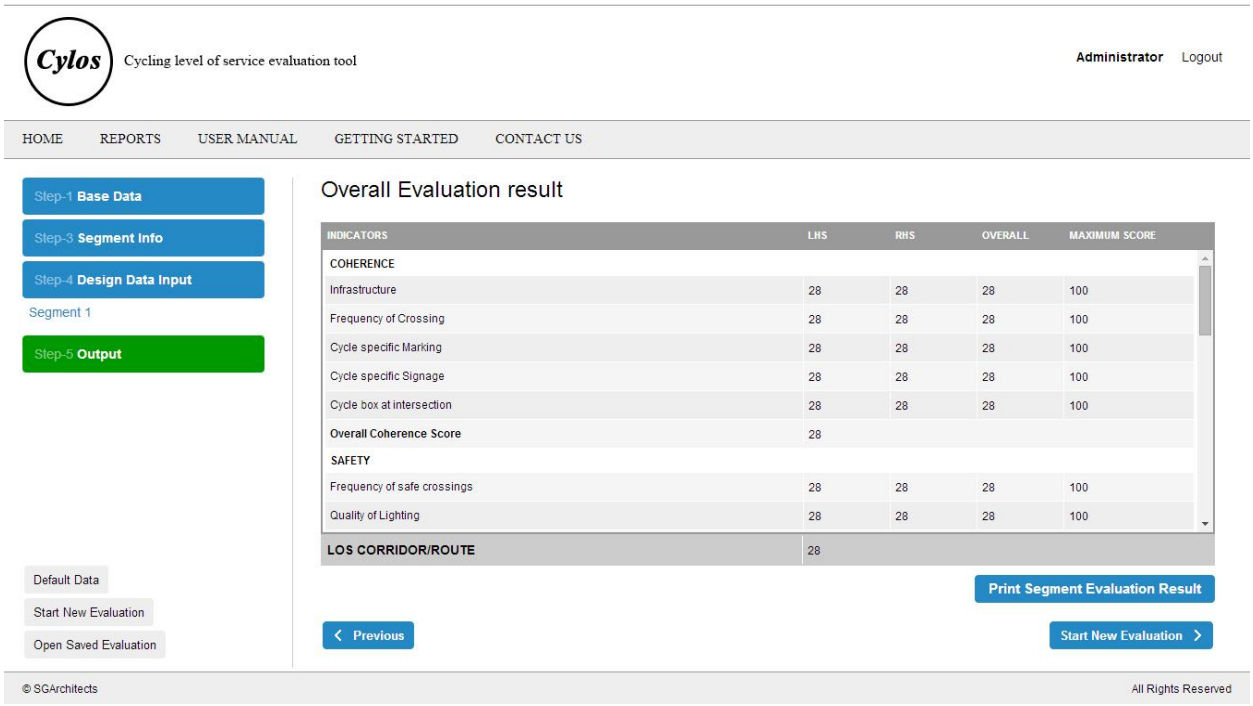


Figure 27: Corridor output form

After completing the evaluation user can perform any of the tasks mentioned below as per his/her will or requirement. These are:

- Can print the result form of the corridor by clicking on the print button.
- Continue with a new evaluation by clicking the start new analysis button.

- Can open the old web forms already filled during evaluation and correct any input value for improvement of level of service of the corridor / route or segment.
- User can Sign-out from the CyLOS tool by clicking the logout button provided on the web page.

The scientific calculations incorporated by the tool for evaluating the segment output as well as the corridor output are defined as formulas, which are developed and induced in the back end part of the tool.

6.5 Forms for Transit access Influence area – Evaluation type

As the user clicks on the 'Transit access influence area' option provided in web form for 'Selection of evaluation type' (Refer **6.4**) the data input forms for the selected evaluation type appears. The data input forms formats developed for Transit access influence area, are similar to the web -forms used for corridor/route evaluation type as the evaluation unit is same in both the cases i.e. assessment of cycling infrastructure on a route. As the evaluation criteria's are identical hence evaluation process also follows the same procedure. Except for one modification that is instead of segments, 'Links' are used to evaluate the cycle facility in transit areas. Therefore, CyLOS tool proposes, transit access area evaluation based on the links.

The transit area is defined as vicinity influenced due to presence of any transit stations like Bus stop; Metro station etc. and the periphery of transit areas is limited based on the catchment of the existing transit stations.

Links are termed as approaches or access leading to the transit areas. As the evaluation of cycle infrastructure in transit areas is based on the links, these linkages have to be limited according to the defined catchment area of the transit stations, Hence in the CyLOS tool, all the access and approaches falling within a radius of 2500 meters, from the transit stations are considered as links.

It is not necessary, that all linkages in transit area directly lead to the transit station. These links forms a network to access the transit stations. Hence these links can be further categorised as

- Primary Links: The approaches/access directly leading to transit stations or in other words the approaches on which the transit station is located. The length of the primary links can vary from 5000m to 6250m based on the route alignment.
- Secondary Links: The approaches leading to the primary links which further leads to the transit stations.

The diagram presented in **Figure 28** shows the primary links and the secondary link in the transit area network.

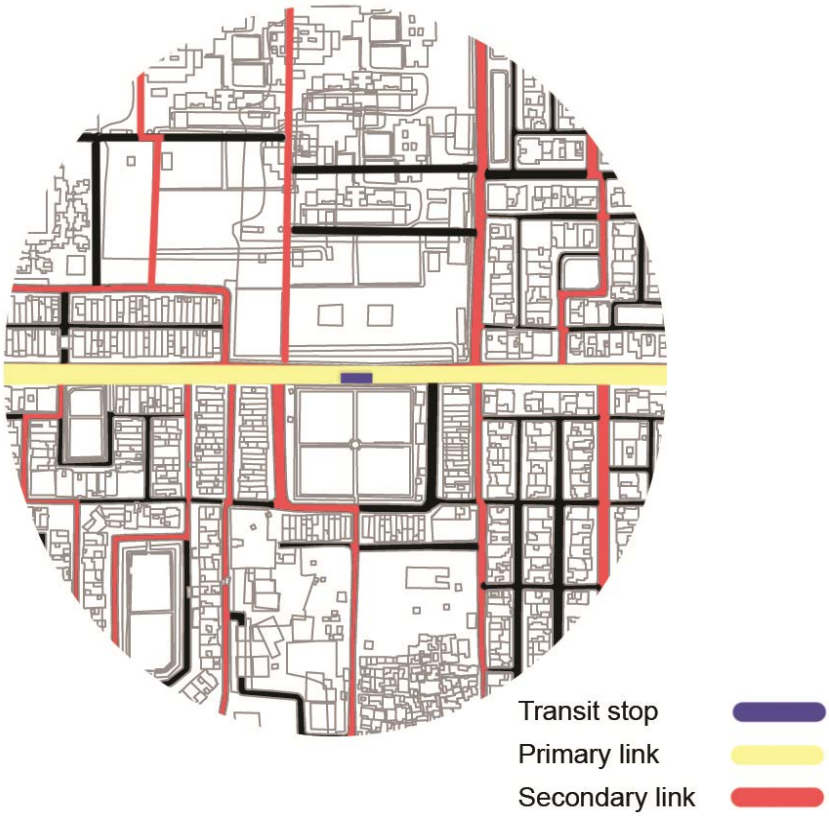


Figure 28: Links categorization

Considering the above mentioned parameters and based on the design details of these identified linkages leading to transit influence areas, the evaluation of the cycle facility is being carried out by the CyLOS tool. So before initiating the evaluation process, the user has to identify the number of the links to be evaluated, and also has to provide details of each link.

Regarding 'Transit access influence area' evaluation type, the user has to insert the number of links to be evaluated in the base data web form and then after has to input the characteristic of each link in the Link information web form which will be appearing after. As mentioned earlier the forms used for transit area evaluation are similar to the corridor /route evaluation hence number of segments is replaced by number of links in the base data form and instead of segment information form, link information form is introduced in transit area evaluation, rest all the other parameters considered are identical. **Figure 29** and **Figure 30** presents the base data form and link information form respectively.

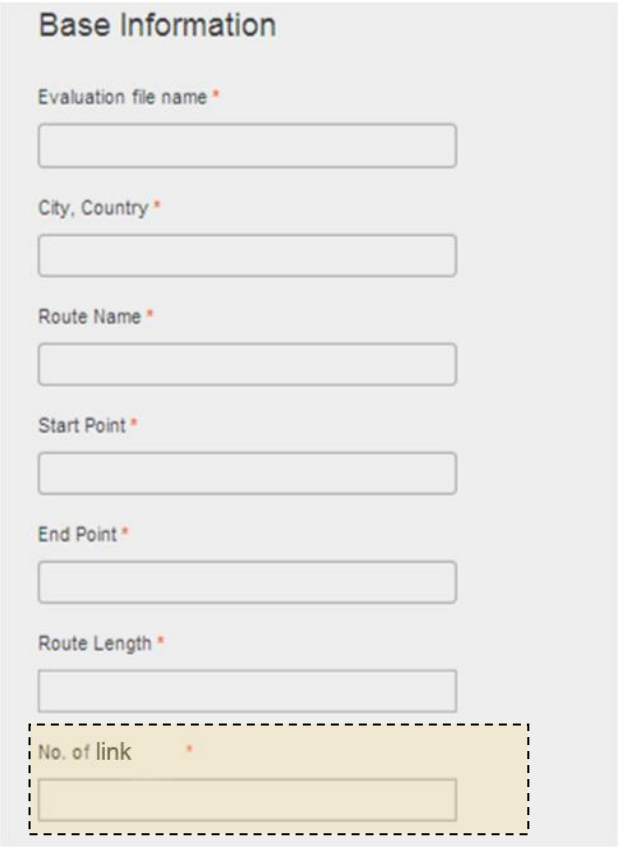


Figure 29: Base Data Form- Transit Access Influence area Evalaution

Figure 30: Link Information Form- Transit Access Influence area Evaluation

The other functions to be performed by the user are same as explained above under corridor/route evaluation type including the design data input web forms (**Refer**: **6.4**). A sample of design data input web form used in transit access influence area evaluation is presented in **Figure 31** with the modifications done with respect to links instead of segments.

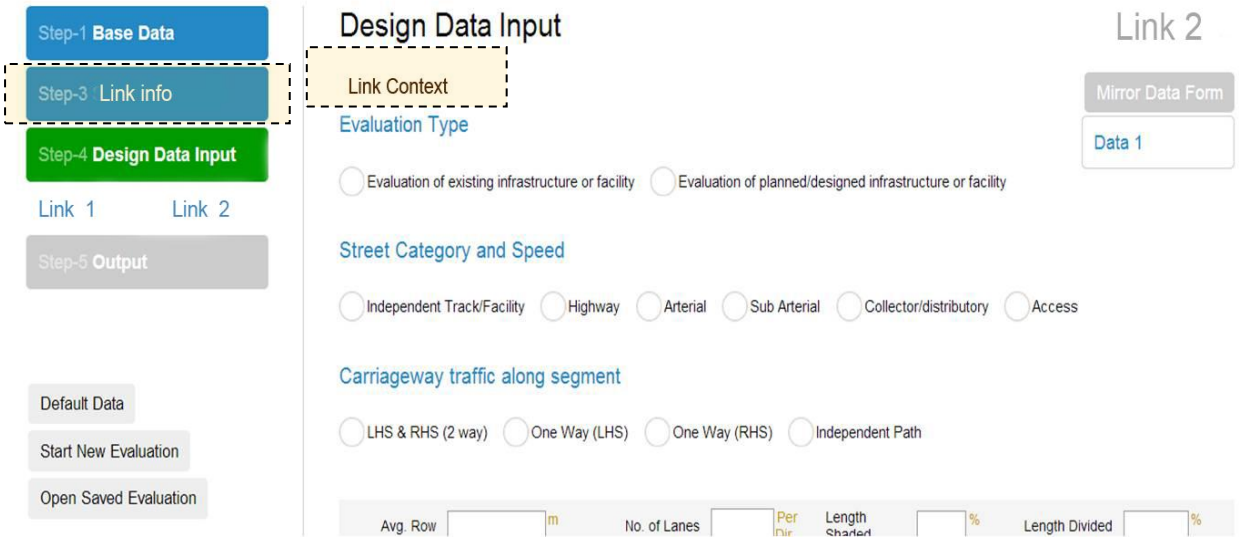


Figure 31: Data input Form- Transit Access Influence area Evaluation

After the data input process is complete and all the forms have been completed for a particular link, a Results page is generated by the tool, specific to the selected link. The Results page gives user, a performance score of the selected link and based on this performance score, the level of service of the link is determined which is provided at end of the link output sheet.

After the user is done with evaluation of all the links, the tool will generate an output/resultant web form, presenting the level of service for the transit access influence area. The scientific calculations done for evaluating the link output as well as the route output are defined as formulas, which are developed and induced in the back end part of the tool. Therefore the evaluation process concludes with this evaluation result form.

6.6 Forms for City wide cycling Network – Evaluation type

As the user clicks on the 'City wide cycling network' option provided in web form for 'Selection of evaluation type', the data input forms for the selected evaluation type appears. The data input forms formats developed for city wide cycling network, is totally different from the web-forms of previous mentioned evaluation types. Under 'City wide cycling network' evaluation type, CyLOS tool proposes to evaluate cycle infrastructure of a city in two ways i.e.

- Measuring cycling level of service, based on the present cycling condition in the city.
- Estimating the cycling potential of city, to develop the city as cycle friendly city in near future.

For the purpose, Front end forms are developed for the city evaluation type which includes set of questions integrated, in web based forms. These web-forms are distributed in 3 broad parts or type of forms. These are:

1. Default data form
2. City data input form

a) City base data form

b) City evaluation form

3. City output form.

Each of these forms is related to each other and whole evaluation process in CyLOS tool is based on the data inserted by the user against the questions asked in the forms. Therefore the user has to input data asked in each of the web form accordingly and in case there is any incorrect input or any of the questions remains unfilled by the user, while inputting data than the tool will automatically generate 'Error messages' regarding the wrong input value or missing value on the web form. These error messages are based on the checks applied to each of questions asked in the forms. Without rectifying the inputs according to the shown error messages, user cannot move forward to the next webpage.

Throughout the evaluation process, while inserting data in the above mentioned web forms the user can move forward to the next form through the 'Next' button provided at bottom right side of the form. The user can move back to the prior web pages in case any alterations are to be done such as changing any default value or updating any information by clicking the 'Previous' button provided at the left hand side bottom of the web page.

6.6.1 City Default data Form

Like previous evaluation types, Default values are assigned by the tool for evaluation of city wide cycling network also and a separate independent web page form: City Default form, is being developed listing all the default values needed in the process of evaluation.

The assigned default values are based on certain standards, conditions and relations derived from the various literature studies, tool kits and researches developed for cycle infrastructure

(**Refer**: **Table 1**) . Based on these values, the city level evaluation is worked out in CyLOS tool. **Figure 32** presents the default form for city evaluation

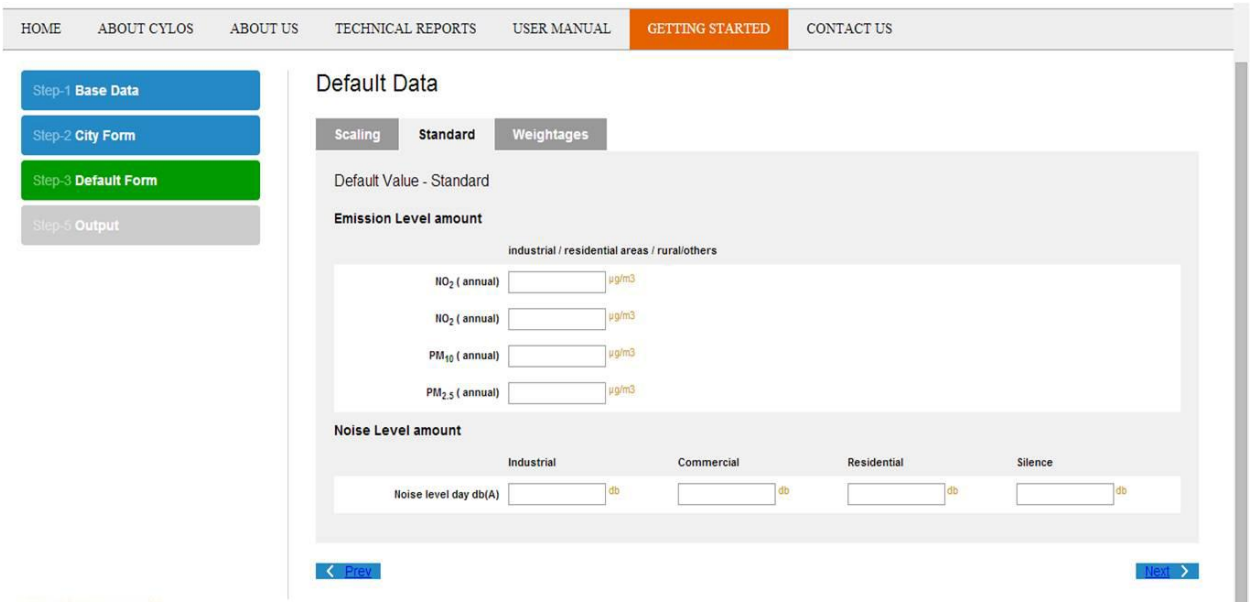


Figure 32: City Default Data form

The CyLOS tool provides user, the option of altering the Default values but changes to these values are not recommended, unless required for research and academic applications. The new values assigned by the user should be based on detail surveys and authentic sources. These values can also be altered for different context and users as per the location of the route, corridor or the city. It is strongly recommended that the user "Restore Defaults "before proceeding with a new analysis, as values edited in a previous analysis may have been retained by the tool.

As the default values assigned by the CyLOS tool are of various types such as some are standard values whereas some values are assigned in form of scores, based on the ranges given to the parameters involved in evaluation. Hence for the better understanding of the user the default form of CyLOS is further divided in three categories which include Standard, Scaling and Weightages. Each field according to the respective category presents the default value of various parameters to be used in the tool for analysis. The 3 different categories shown in Default form web pages are as follows:

a) **Standards**: As the user clicks the 'Standard tab', a webpage will appear showing all the standard default values assigned by the tool.

b) **Scaling**: As the user clicks the 'Scaling tab', a webpage will appear showing default scores assigned against the ranges decided for parameters involved in evaluation process. The

scores are assigned in scale of 0 to 1 depending on the best and worst scenario for each parameter such that the best condition is given the score of 1 and worst condition is given score of 0.

c) **Weightages:** As the user clicks the 'weightages tab', a webpage will appear showing all the default weightages assigned by the tool against the parameters and the identified indicators. Presents the weightages default page.

6.6.2 City data input Forms

Under City wide cycling network, CyLOS tool proposes evaluation of present status of cycle infrastructure and the cycling potential of a city, therefore all the parameters, based on the city statistics and the factors revealing the present cycling level of service of the city are taken in to account and framed as City data input web form. But as all input requirements cannot be amalgamated in one single questioner and for the better understanding and ease of the user, the data input form is further distributed in to two different web-forms. These web-forms are explained in the sections below:

6.6.2.1 City Base data Form

'City Base-data' form appears as the first front-end data input form to be filled by the user. To start the evaluation the user has to input basic information related to the city such as name of the city, state, country, total area and demography. The data input also consist of the data points regarding transportation profile of the city like total trips, per capita trip rate of the city, Average trip length of the city and modal share. Apart from the above mentioned information the user also has to insert an planor image of the city . This data input can be any image format(jpeg/ png/ gif / bmp or any other image format).

Figure 33 presents the city base data input form.

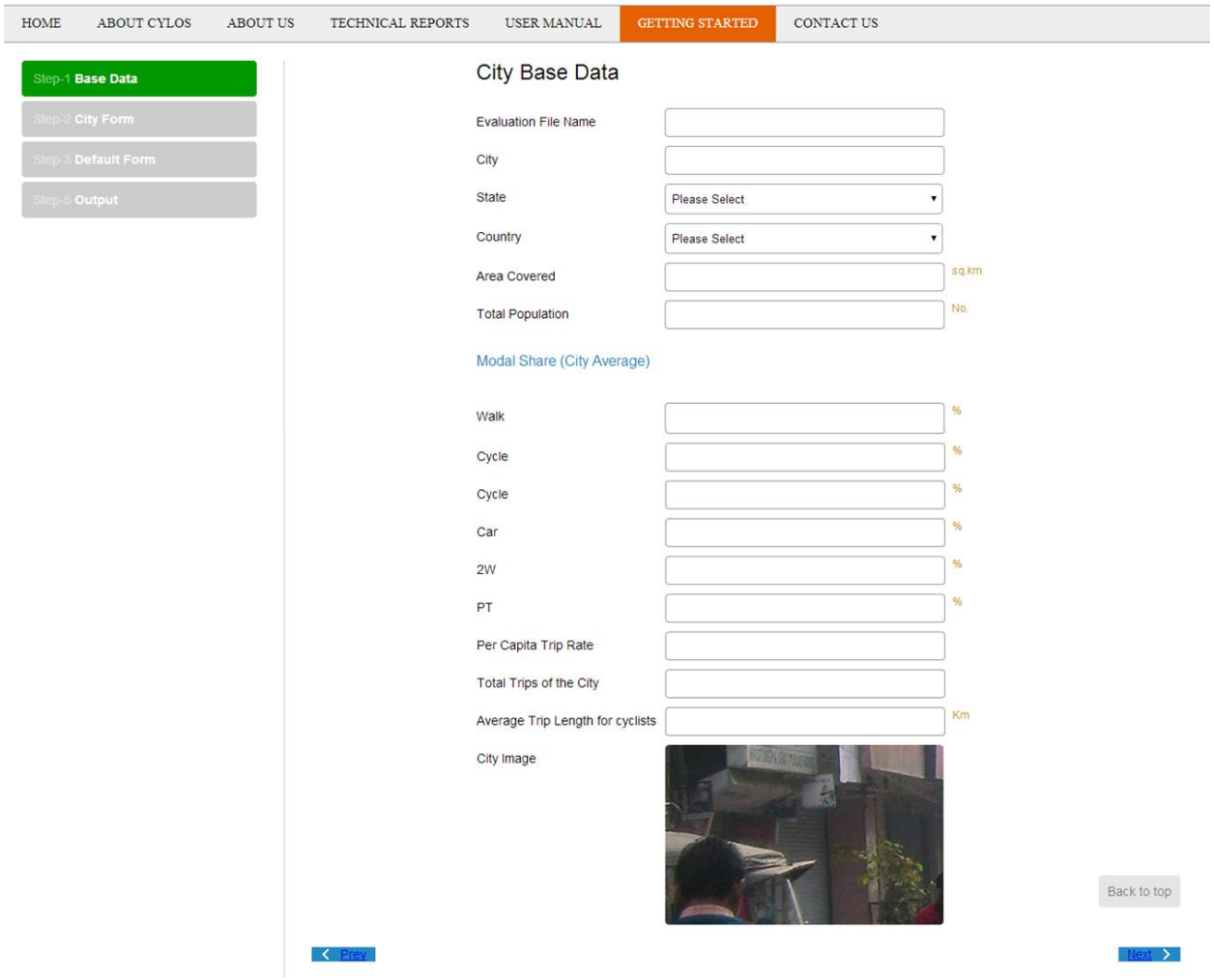


Figure 33: City Base Data form

6.6.2.2 City Evaluation Form

This data input web form appears after the city data form is filled by the user. The form is designed based on the framed set of questions related to context of existing cycling conditions in a city. **Figure 34** shows the City evaluation web form.

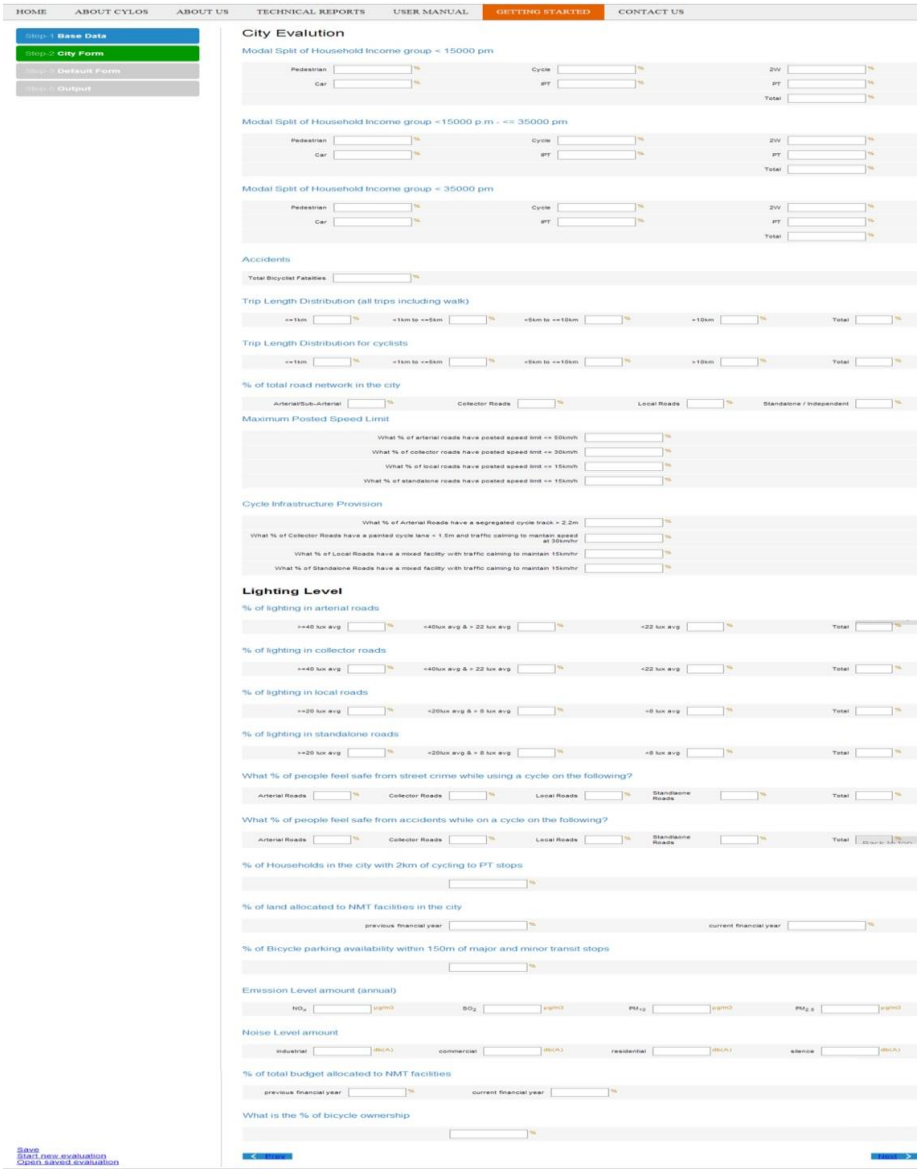


Figure 34: City Evaluation Data form

This web form can be considered as the main data input form for city assessment. The form is designed based on 14 parameters. These are as follows:

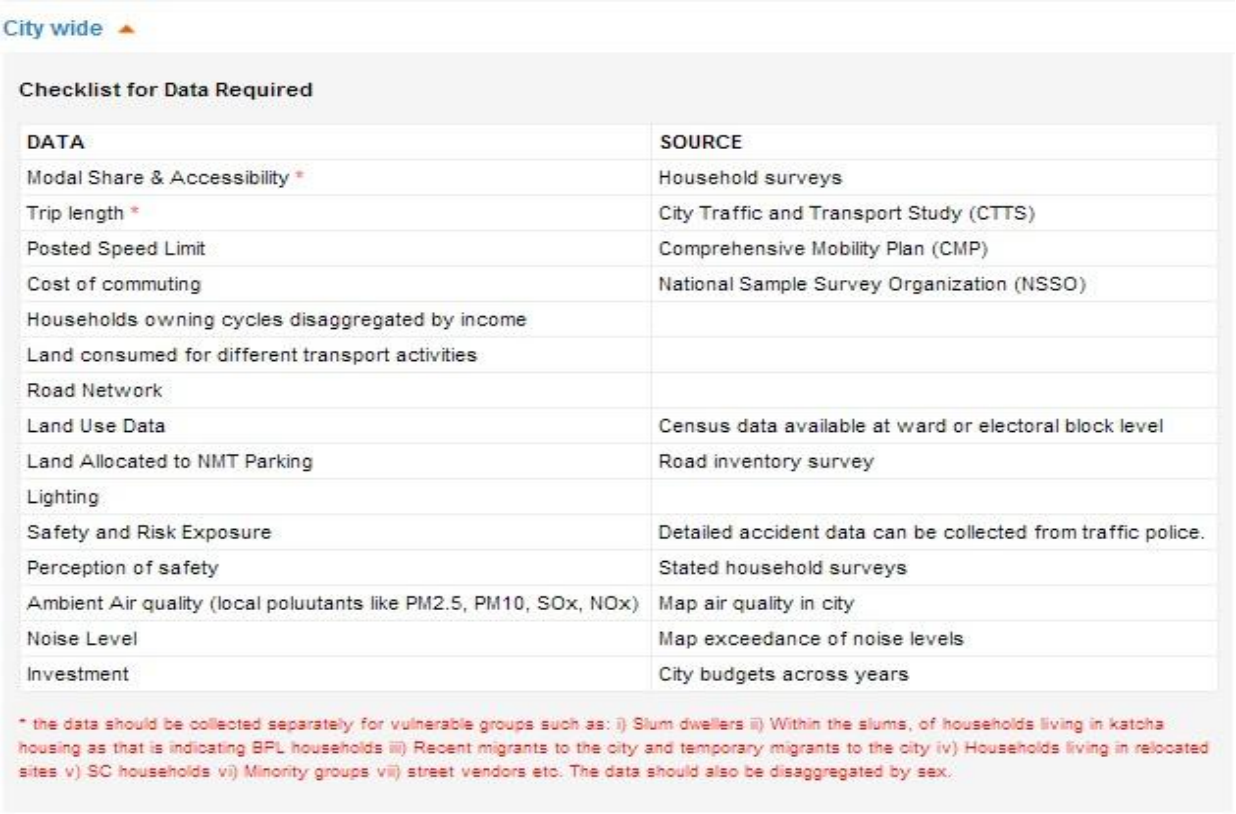
- Modal split
- Bicycle fatalities
- Trip length distribution
- Percentage of road network in the city (according to road typology)
- Speed

- Cycle infrastructure provision
- Lighting
- Safety (in terms of street crime and accidents)
- Trips by cycling to public transport
- NMT land allocation
- Availability of cycle parking
- City Emissions
- Noise levels
- Revenue for NMT facilities
- City Bicycle ownership

Each of the parameters is being explained and elaborated in the User manual provided for CyLOS tool.

It can be well observed that the user needs to collate a different set of data for this evaluation type. For better understanding of the user, an inventory (check list) of the data points to be collected is being induced below data requirement against city level evaluation type in the 'Getting started' web page link .

Figure 35 presents the check list for the city level evaluation.



City wide

Checklist for Data Required

DATA	SOURCE
Modal Share & Accessibility *	Household surveys
Trip length *	City Traffic and Transport Study (CTTS)
Posted Speed Limit	Comprehensive Mobility Plan (CMP)
Cost of commuting	National Sample Survey Organization (NSSO)
Households owning cycles disaggregated by income	
Land consumed for different transport activities	
Road Network	
Land Use Data	Census data available at ward or electoral block level
Land Allocated to NMT Parking	Road inventory survey
Lighting	
Safety and Risk Exposure	Detailed accident data can be collected from traffic police.
Perception of safety	Stated household surveys
Ambient Air quality (local poluutants like PM2.5, PM10, SOx, NOx)	Map air quality in city
Noise Level	Map exceedance of noise levels
Investment	City budgets across years

* the data should be collected separately for vulnerable groups such as: i) Slum dwellers ii) Within the slums, of households living in katcha housing as that is indicating BPL households iii) Recent migrants to the city and temporary migrants to the city iv) Households living in relocated sites v) SC households vi) Minority groups vii) street vendors etc. The data should also be disaggregated by sex.

Figure 35: City Check list

The required information can be extracted from the secondary data and surveys available in the prior researches and studies such as stated house hold surveys, city mobility plans etc done before for the cities.

6.6.3 City Output Form

After the data input process is complete and all the forms have been completed, a Results page is generated by the tool. This result page is termed as 'City Output form'. The Results page gives user, a performance score for the city. This performance score is formulated in the back-end calculations devised by the tool. Based on this performance score, the cycling level of service for the city is determined which is provided at end of the output sheet.

The assessment of city wide cycling network is carried out on the basis of selected indicators influencing cycling in city. These indicators are derived from the various sub-indicators developed from the input data provided by the user in the input forms. The output sheet generates performance score against each of these involved indicators.

Each indicator involved in evaluation process is assigned with default weightages assigned by tool and based on these weightages; the user can go to the weightages tab provided in the default form and can alter the assigned weightages as per his/her needs. The performance score earned by each indicator when applied to their respective weightages assigned by the tool and aggregated in the back end computation by the tool produces the level of service.

As mentioned above, in case of 'City wide cycling network' evaluation, CyLOS tool proposes to evaluate cycle infrastructure of a city under two different criteria's i.e. Measuring cycling level of service, based on the present cycling condition in the city and Estimating the cycling potential of city hence the tool collates the indicators influencing the respective criteria and generates two different level of services for each mentioned criteria in the CyLOS tool. The obtained level of service for each criterion is rated on a scale of 0 to 100, such that higher the score obtained signifies higher level of service and vice versa. **Figure 36** presents the web page of City output form.

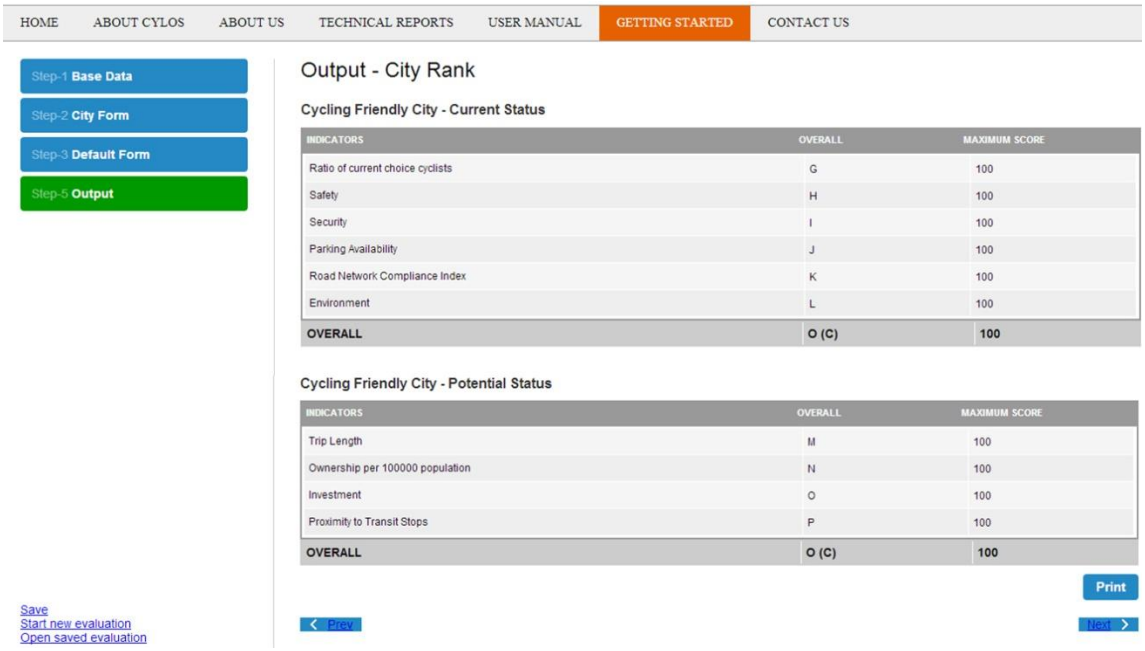


Figure 36: City Output web form

The scientific calculations done for evaluation are defined as formulas, which are developed and induced in the back end part of the tool. Therefore the evaluation process of city wide cycling network concludes with this city out form.

7 Back End Computation and Evaluation

'Back end' refers to the estimation and computation of the data collected by the tool to generate a complete picture of the cycling facility being evaluated and then to subsequently evaluate the same. Back end evaluation combines and computes different data input in the form, with a goal to provide an assessment of cycle infrastructure base on the type of evaluation selected by the user.

7.1 Evaluation Methodology

CyLOS tool proposes to evaluate cycling infrastructure at three broad levels. These are:

1. Cycling Route.
2. Transit (or specific function) access network.
3. City wide cycling infrastructure availability assessment.

The proposed base for evaluation in case cycling route evaluation and transit access network is cycling route, which is evaluated based on detailed design inputs. Therefore, multiple cycling routes can be graded, and an overall grading of these routes is provided using weighted means method. In case of cycling route evaluation, a individual cycling route is considered as a segment whereas in case of transit access network evaluation a individual cycling route is considered as link. The evaluation of each cycling route, (segment or link: based on the evaluation type) has been broken down in to indicators influencing cycling requirements. These indicators derived from the multiple sub indicators developed from the data inserted by the user in the front end web pages.

Each of indicators involved in the evaluation process contributes to the five well known categories affecting cycling requirements. These are:

1. **Cohesion** – relates to continuity and readability of infrastructure
2. **Directness** – relates to directness in space (no detours) and directness in time (reduced travel time).
3. **Safety** – Relates to safety from accidents and security from crime.
4. **Comfort** – Relates to physical comfort experience by cyclist, example shade and smooth ride.
5. **Attractiveness** – Relates to visual and physical attractiveness of the route environment.

The evaluation is proposed to be presented as disaggregated results under each indicator in each of the above categories. To arrive at an aggregated result or score, these results are

needed to be aggregated, for which they are assigned with defined weightages. Current evaluation method uses assumed weightages assigned as default in the tool. However the default values form in the tool allows users to change these weightages. It is proposed that the default value of each of these weightages be arrived at using inputs from experts and stakeholders in bicycle infrastructure planning. The same is proposed to be undertaken using a questionnaire based survey (to be analysed using AHP method).

While city wide cycling network assessment is undertaken by directly inducing indicators impacting the cycling status and prospective of a city and inserting their assessment along with inputs, an overall representation of the city is done.

7.2 Evaluation Framework: Cycling Corridor/Route

Assessment of cycling route is based on segment based evaluation. Each route can be broken in to distinct segments (based on features as well planning and design conditions), and input separately. The tool shall undertake individual assessment of each segment and then aggregate the same in to an overall evaluation by giving weightages based on length and road/street category under each segment. For example infrastructure could be an independent track, on a highway, on an arterial road, on a sub arterial road, on a collector street or on an access road. Each road type presents a different context and hence weightages of indicators between these cannot be the same. The assessment is undertaken separate for each side of the road (left hand side (L.H.S) and right hand side (R.H.S), separate for mid blocks (between intersections) and intersections. These separate evaluations are then aggregated in to an overall segment evaluation (or an evaluation score). This evaluation when aggregated with their individual indicator provides and overall assessment of each segment. Further different segment assessment then combines to provide a route assessment.

7.2.1 Indicators: Cycling Corridor/Route

To simplify the process, the data points mentioned in the web forms, have been assessed under 80 multiple derived indicators. These indicators then combine and generate evaluation under different primary indicators. A total of 26 primary indicators are evaluated. These indicators combine to evaluate the infrastructure under each of the mentioned five categories. **Figure 37** presents the relationship between these derived indicators, indicators and their categories.

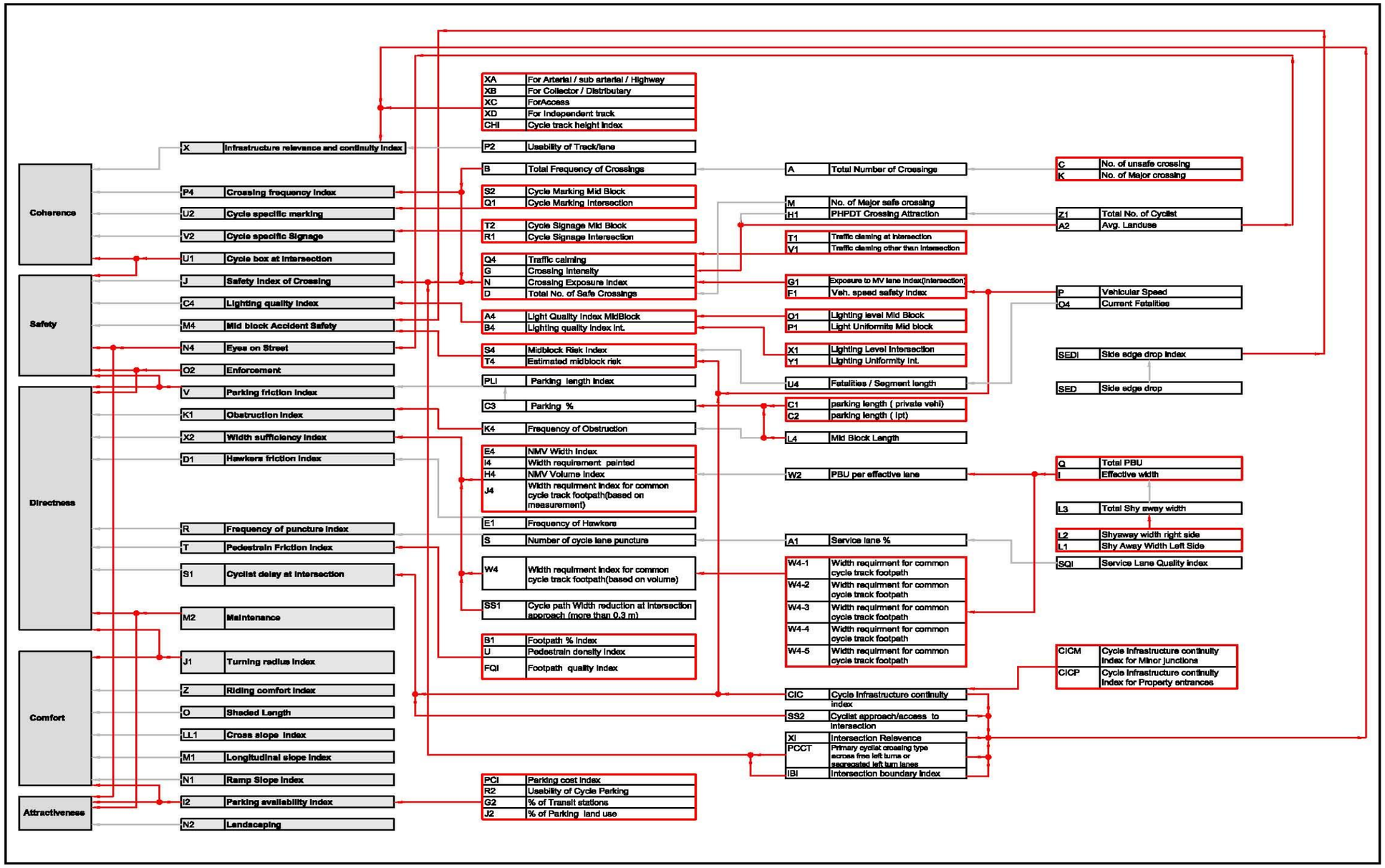


Figure 37: Flow chart showing relationship between Categories, derived indicators and Indicators

The 26 primary indicators used for the evaluation of cycling route/corridor are as follows:

1. **Infrastructure Relevance and Continuity Index:** This Indicator contributes to coherence category and refers, how relevant is planned/constructed infrastructure to its context. This indicator includes other sub indicators developed from the input inserted by the user in front end web forms. These sub indicators are as follows:
    - Relevance of cycle infrastructure according to road typologies: Indicates the relevance of the provided cycle infrastructure based on the type of road (Arterial, Sub-arterial, Highway, collector, access and standalone track).
    - Usability of cycle tracks/ lane: Indicates the relevance of the provided cycle infrastructure based on level of usability i.e. percentage of cyclist using the facility along the segment.
    - Intersections Relevance: Indicates the relevance of the provided cycle infrastructure based on the type of intersections (Signalized, un-signalized, one lane roundabout, two lane round about, rotary and grade separated junction)
    - Primary cyclist crossing type at segregated left turns and on the intersection boundary: Indicates the relevance of the provided cycle infrastructure based on the cyclist crossing type provided on segregated left turns and on the boundaries of the intersection.
    - Cycle infrastructure continuity at minor junctions and property entrances: Indicates the relevance of the provided cycle infrastructure based on continuity of cycle path at the minor junctions and the property entrances.
    - Cyclist approach to the intersections: Indicates the relevance of the provided cycle infrastructure based on the type of infrastructure provided while approaching an intersection.
    - Cycle track height index: Indicates the relevance of the provided cycle infrastructure based on the height of the cycle facility on the segment.
2. **Crossing frequency index:** This Indicator contributes to coherence category and refers to how frequent are available opportunities for cyclists to cross the road. Crossing frequency index is based on the total frequency of the crossings existing on the cycle path.
3. **Cycle Specific Marking:** This indicator contributes to coherence category and refers to availability of adequate pavement marking to guide, warn and regulate cyclists. This primary indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring presence of cycle marking at midblock and intersections.

4. **Cycle specific Signage:** This indicator contributes to coherence category and refers to availability of adequate sign boards to guide, warn and regulate cyclists. This primary indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring presence of cycle signage at midblock and intersections.
5. **Cycle Box at Intersection:** This indicator contributes to two categories- Safety and Coherence. It indicates the availability of cycle box marking at intersection to hold crossing cyclists. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring presence of cycle box at intersections.
6. **Safety index of crossings:** This indicator contributes to safety category and refers to the level of safety in terms of crash risk and severity, at cyclist crossing facilities. This Indicator aids to evaluates, how safe are the crossings for the cyclist. This primary indicator includes other sub- indicators involved in evaluation process. These sub indicators are as follows:
    - Traffic calming: Indicates the provision of traffic calming used at intersections and other than intersections (midblock).
    - Intensity of crossings: Indicates crossing intensity of the cyclist based on the weighted average land use along the segment and crossing attraction per hour per direction.
    - Crossing exposure index: Based on cyclist exposure to MV lane and vehicular speed safety index, indicates exposure of the cyclist while crossing at the intersection.
    - Crossing attraction per hour per direction: Indicates crossing attraction of the cyclist based on total number of cyclist.
    - Exposure to motor vehicle lane index: Depending on the number of lanes provided in a segment helps in determining the exposure of cyclist at an intersection while crossing.
    - Vehicle speed safety index: This index is developed based on the vehicular speed and road type provided in the segment or the corridor indicating safety of the cyclists.
    - Total number of safe crossings: Based on the number of major safe crossing provided on the segment indicates safe crossings for the cyclists.

These sub- indicators are developed from the input inserted by the user in front end web forms like presence of traffic calming, vehicular speed and number of lanes on the carriage way etc.

7. **Lighting Quality Index:** This indicator contributes to safety category and refers to the quality of lighting in terms of level and uniformity at midblock and intersections. This

indicator includes the sub indicators - lighting quality index at midblock and intersections. These sub- indicators are derived from the input inserted by the user in front end web forms for lighting levels and uniformity at midblock and intersections.

8. **Midblock accident Safety:** This Indicator contributes to safety category and refers to the assessment of accident risk for cyclist along the carriageway. This indicator is comprised of many other sub indicators. These are:
    - Midblock risk index: The index, Indicates the amount of risk involved for the cyclist at midblock based on the total number of fatalities per segment length.
    - Fatalities per segment length: Indicates the number of current fatalities on the midblock.
    - Estimated midblock risk: This indicator estimates risk for the cyclist at midblock based on the vehicular speed at the midblock section and the primary segregation type of the cycle facility from the carriage way.
    - Side edge drop index: This index is developed on the basis of depth of the side edge such that more the depth, high is the risk for the cyclist.
    - Cycle infrastructure continuity: Indicates level of risk of the cyclist involved based on continuity of cycle path at the minor junctions and the property entrances .As more the cycle facility is discontinuous at minor junctions and the property entrances more it increases the chances for the cyclist to ply on the carriage way rather than the provided cycle infrastructure causing accidents.

These sub- indicators are derived from the input inserted by the user in front end web forms against the data points enquired side edge drop, current fatalities, cycle infrastructure continuity at minor junctions and property entrances and vehicular speed.

9. **Eyes on street:** This Indicator contributes to two categories- Safety and Attractiveness. It indicates assessment of level of activities along the segment ensuring security (safety) as well as refers to attraction of cycling infrastructure in terms of life/ activity along cycling path. Eyes on street are based on the percentage of the segment covered by hawkers and the corresponding land use present on the either side of the infrastructure.
10. **Enforcement:** This indicator contributes to two categories- Safety and Directness. It indicates the assessment of level of enforcement to ensure safety on carriageway and minimal loss of directness to cyclists. This primary indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring level of enforcement for the segment.
11. **Friction from Car Parking:** This indicator contributes to two different categories- Safety and Directness. The indicator refers to the assessment of risk posed by street parking and loss of directness from friction by street parking to commuting cyclists. This

indicator involves only one major sub indicator i.e. parking length index, which is based on the percentage of parking availability depending upon the parking length inserted by the user asked in the front end forms for the private vehicles and intermediate public transport (IPT) separately.

12. **Obstructions Index:** This indicator refers to the assessment of loss of directness caused by presence of obstruction in cycling path. Obstruction index is based on the frequency of the obstruction existing on the cycle path. It contributes to directness category.
13. **Width Sufficiency index:** This indicator refers to the assessment of sufficiency of cycling path width with respect to existing infrastructure typology. It contributes to directness category. This primary indicator includes 6 major sub indicators. These are:
    - NMV width index: This index is created depending upon minimum width provided and indicates the required width to be provided in case of segregated cycle track
    - NMV volume index: This index is created depending upon PBU per effective lane and indicates required volume in case of segregated cycle track. Passenger bicycle unit or PBU is termed to be a unit equivalent of a single cycle in comparison to other cycling modes discussed in the user input forms.
    - Width requirement for painted cycle track: Depending upon the minimum width provided The indicator shows the width requirement, for a painted track or lane
    - Width requirement for common cycle track foot path (Measurement based): This indicates requirement of width, needed for a common cycle track footpath based on minimum width provided.
    - Width requirement for common cycle path (Volume based): This indicates requirement of width needed for a common cycle track footpath based on the combined volume of non motorized vehicles (NMV) and pedestrians.
    - Cycle track width reduction at intersection approach: While approaching any intersection, this indicator shows the reduced width requirement such that if the width of the cycle facility reduces by more than or equal to 0.3 meters will reduce the directness of the cycle infrastructure.

These sub- indicators are developed from the input inserted by the user in front end web forms like total shy-away width, total passenger bicycle unit (PBU), total number of pedestrians and total number of cyclist.

14. **Hawker friction index:** The indicator contributes to directness and refers to the assessment of loss of directness due to friction from hawkers on cycling path. Hawker friction index is based on the frequency of the hawkers existing along the cycle path.
15. **Frequency of punctures Index:** This indicator contributes to directness and refers to how often is cycling lane/path crossed by vehicular path to access service lane. This

indicator is derived, based on existing number of cycle lane punctures along the corridor. The index signifies if the frequency of punctures is high then directness gets reduced for the provided cycle facility. The numbers of cycle lane punctures varies according percentage of service lane inserted by the user in the front end web forms. Hence the quality of the service lane also affects the directness as if the service lane provided is of poor quality will tend the cyclist to detour from the cycling path reducing directness. The quality of service lane is determined by the service lane quality index.

16. **Pedestrians Friction Index:** This indicator contributes to directness and refers to the assessment of loss of directness due to friction from pedestrians on cycle path. This indicator is derived, based on pedestrian density index. The index signifies if the density of the pedestrian is high i.e. space allocated to the pedestrians (sqm/person) is low, will tend the pedestrians to move into the cycle path increasing friction between the cyclists and pedestrian resulting in reduction of directness for the provided cycle facility. The pedestrian friction varies according to on the percentage of footpath provided along the cycle facility. Hence the quality of the footpath also affects the directness as if the footpath provided is of poor quality will increase the cyclist pedestrian friction on cycling path reducing directness. The quality of footpath is determined by the footpath quality index.
17. **Cyclist Delay at Intersection:** This indicator contributes to directness and refers to the assessment of loss of directness due to delay to cyclists at intersections. This indicator includes 2 other aspects or sub indicators for evaluation. These are:
    - Cycle infrastructure continuity index: This index is created depending upon continuity of cycle path at the minor junctions and the property entrances. It indicates the loss of directness of the cyclist, in case cycle path is discontinuous at the minor junctions and property entrances.
    - Cyclist approaches/ access to intersection index: This index is created depending on the type of infrastructure provided while approaching an intersection. It indicates the loss of directness of the cyclist, in case cycle path is discontinuous while approaching an intersection.
18. **Maintenance:** This indicator contributes to two categories- Directness and attractiveness. It indicates assessment of loss of directness due to friction cause by poor maintenance/cleaning cycle infrastructure and attractiveness of cycling infrastructure in terms of how well it is maintained. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the maintenance level of the cycle infrastructure.
19. **Turning Radius Index:** The indicator contributes to two categories – Comfort and Directness. This indicator refers to the assessment of loss of directness and comfort due to tight turning radiuses on cycling path. This indicator is directly derived from the input

inserted by the user in front end web forms under the data points enquiring the turning radius present on the cycle infrastructure.

20. **Riding comfort Index:** This indicator contributes to comfort category and refers to the assessment of riding comfort with reference to surface type. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the existing surface type on the cycle infrastructure.
21. **Shaded Length:** This indicator contributes to comfort category and refers to the assessment of protection from weather in terms of shade/shelter over cycling path. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the percentage of shaded length on the cycle infrastructure.
22. **Cross slope index:** This indicator contributes to comfort category and refers to the assessment of water runoff capability and comfortable riding cross slope. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the cross slope given on the cycle infrastructure.
23. **Longitudinal slope index:** This indicator contributes to comfort category and refers to the assessment of comfortable riding longitudinal slope. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the cross slope given on the cycle infrastructure.
24. **Ramp Slope Index:** This indicator contributes to comfort category and refers to the assessment of comfort of ramps provide to access egress from cycle path. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the cross slope given on the cycle infrastructure.
25. **Parking Availability:** The indicator contributes to two categories – Comfort and Attractiveness .The indicator refers to the assessment of cycling comfort and attractiveness in terms of availability of safe and secure cycle parking. This indicator is based on 4 other aspects or sub indicators for evaluation. These are:
    - Parking cost Index: The index reveals level of attractiveness, based on cost of cycle parking per day along the segment.
    - Usability of cycle parking: This indicates percentage of cyclists using the parking facility provided
    - Percentage of transit Stations: Indicates percentage of transit stations provided with parking facility on the segment.
    - Percentage of parking land use: Indicates percentage of Land use served with parking facility on the segment.

These sub- indicators are developed from the input inserted by the user in front end web forms like total parking cost, percentage of parking covered by transit stations and land use.

26. **Landscaping:** This indicator contributes to attractiveness category and refers to attractiveness of cycling infrastructure in terms of alongside landscaping/ plantation. This indicator is directly derived from the input inserted by the user in front end web forms under the data points enquiring the landscaping level on the cycle infrastructure.

7.2.2 Indicators Formulation: Cycling Corridor/Route

As mentioned earlier (**Refer**-**6.4**) in the front end user forms, each of the input in these forms has been assigned a distinct number/code for evaluation and the same is used in the forms. Detailed description of each input along with required information for users has already been compiled in the user manual for the tool. Based on this numbering or coding, evaluation or assessment for each of the derived indicators as well as the sub-indicators are defined as a formula, linking inputs from the 'front end' forms (including user and default value forms).

For example: Formula for 'Total number of crossing' is represented as:

A= (3_3f+C+K+ ((4D_24a+4D_24b)*2_4

In the above formula, total number of crossings which is derived indicator is represented as 'A' Here 'A' refers to the derived indicator code. Similarly 'C' refers to Number of Unsignalized /Unsafe Crossing and 'K' refers to number of major crossings which are also derived indicators but contribute in 'A', while code type {3_3f: Number of safe crossings (Segment information form), 4D_24a and 4D_24b: number of grade separated cycle crossing fob and subways (Design input data form for intersections and crossings) and 2_4: 50% of cyclist crossing considered in case of grade separated crossing as default value(Default form)} all refers to inputs from the user form.

Likewise formulas (relationships) are developed for each indicator and derived indicators shown in **Figure 37**, which are involved in the evaluation process considering both sides i.e. L.H.S and R.H.S using the assigned codes. Each component used in formulas, worked out for the derived indicators are compiled and presented together in **Annexure10.1**

Assessment of transit access influence area is based on link based evaluation. Each route can be broken in to distinct links (based on features as well planning and design conditions), and input separately. The tool shall undertake individual assessment of each link and then aggregate the same in to an overall evaluation by giving weightages based on length and road/street category under each link. The assessment is undertaken separate for each side of the road (left hand side (L.H.S) and right hand side (R.H.S), separate for mid blocks (between intersections) and intersections. These separate evaluations are then aggregated in to an overall link evaluation (or an evaluation score).This evaluation when aggregated with their individual indicator

provides and overall assessment of each link. Different link assessment then combines to provide a route assessment.

7.2.3 Indicators: Transit access Influence area

As the data points and the input web forms, are similar to that of the cycle corridor/ route evaluation type hence the indicators and the evaluation process is worked out on the similar grounds. Therefore, alike derived indicators are being deployed for transit access influence area evaluation type. Therefore web forms have been assessed based on 80 multiple derived indicators. These indicators further combine and generate evaluation under different primary indicators. Total 26 primary indicators are identified for evaluation. These indicators combine to evaluate the infrastructure under each of the mentioned five categories. But as this transit area evaluation type is based on links, in some of the derived indicators, new sub indicators are induced based on the links.

For example: Crossing frequency index contributing to coherence category in corridor/ route evaluation type is replaced by Accessibility index (coded as P4) in transit access influence area evaluation. Although this derived indicator also contributes to coherence category but includes a new sub indicator: Link density index. The 'Link density index' (coded as Y3) indicates average distance between two distinct links. This sub-indicator is developed from the input inserted by the user in front end web forms under the data points enquiring the total number of links (primary + secondary) existing in the transit area, and the catchment of the transit station. **Figure 38** presents the relationship between these derived indicators, indicators and their categories.

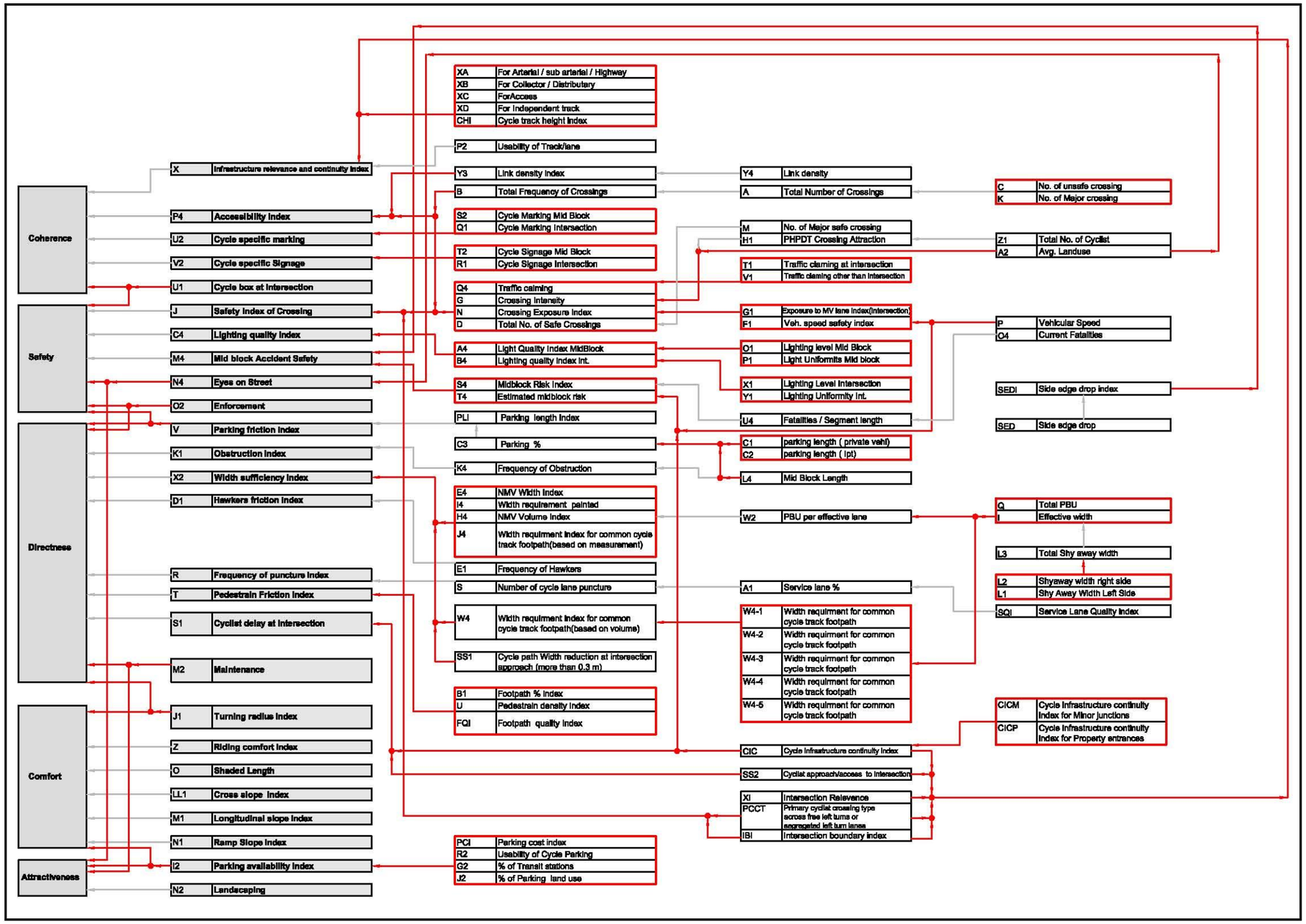


Figure 38: Flow chart showing relationship between Categories, derived indicators and Indicators (transit access influence area

It can be observed from the above indicator relationship flowchart; only one derived indicator i.e. Accessibility index (coded as P4), which has been explained in detail in above example, differs from the indicators used for evaluating cycling route /corridor. Rest all the other 25 primary indicators are identical and are already explained in detail in the previous section (**7.2.1**)

7.2.4 Indicators Formulation: Transit access Influence area

Since the indicators used in transit access influence area same as the indicators used in cycle corridor/route evaluation type. Therefore the formulas developed are also identical except for the formulas developed for Accessibility index (coded as P4), where the new sub indicators 'Link density index' (coded as Y3) and Representation of Link density (coded as Y4) are induced.

These indicators formulas are developed, linking inputs from the 'front end' forms (including user and default value forms). As mentioned earlier (**Refer**-**6.4**) in the front end user forms each input in these forms has been assigned a distinct number/code for evaluation and the same is used in the forms. Detailed description of each input along with required information for users has already been compiled in the user manual for the tool. Based on this numbering or coding, assessment for the derived indicators as well as the sub- indicators is worked out.

For example: Formula for 'Representation of Link density' is represented as:

$$Y4 = (2\_151*4)/ (1\_7-1)$$

In the above formula, Representation of Link density, which is an indicator is represented as 'Y4' Here 'Y4' refers to the indicator code. While code type {2_151: Accessibility influence zone radius (Default form), 1_7: number of links to be evaluated (Base data form for transit access influence area)} all refers to inputs from the user form.

Likewise formulas (relationships) are developed for each indicator and derived indicators shown in **Figure 38**, which are involved in the evaluation process considering both sides i.e. L.H.S and R.H.S using the assigned codes. Each component used in formulas, worked out for the derived indicators are compiled and presented together in **Annexure**Error! Reference source ot found. Rest all the formulas developed for each primary indicator are identical to the formulas developed for corridor/ route evaluation.

7.3 Evaluation Framework: City wide cycling network

'City wide cycling network' evaluation, proposes to evaluate cycle infrastructure of a city under two different categories:

1. **Cycling Friendly City (Current Status):** This refers to the present state of the city in terms of its structure and compatibility of its cycling infrastructure.

2. **Cycling Friendly City (Potential Status):** This refers to the potential state of the city for it to achieve a higher cycling friendly status.

Taking both this categories into consideration, certain indicators are identified contributing to each category. These indicators are based on the input data provided by the user in the front end input forms. These indicators further combine and generate primary indicators. The tool undertakes the assessment of each primary indicator separately and then aggregates the same in to an overall evaluation score to provide a city level assessment separately for the both mentioned categories.

7.3.1 Indicators: City wide cycling network

The data points mentioned in the web forms, have been assessed under 11 multiple derived indicators. These indicators then combine and generate evaluation under different primary indicators. A total of 10 primary indicators are identified for evaluation of city wide cycling network. These primary indicators are distributed in two parts to evaluate the city level of service under each of the mentioned criteria's. **Figure 39** presents the relationship between these derived indicators, indicators and their categories.

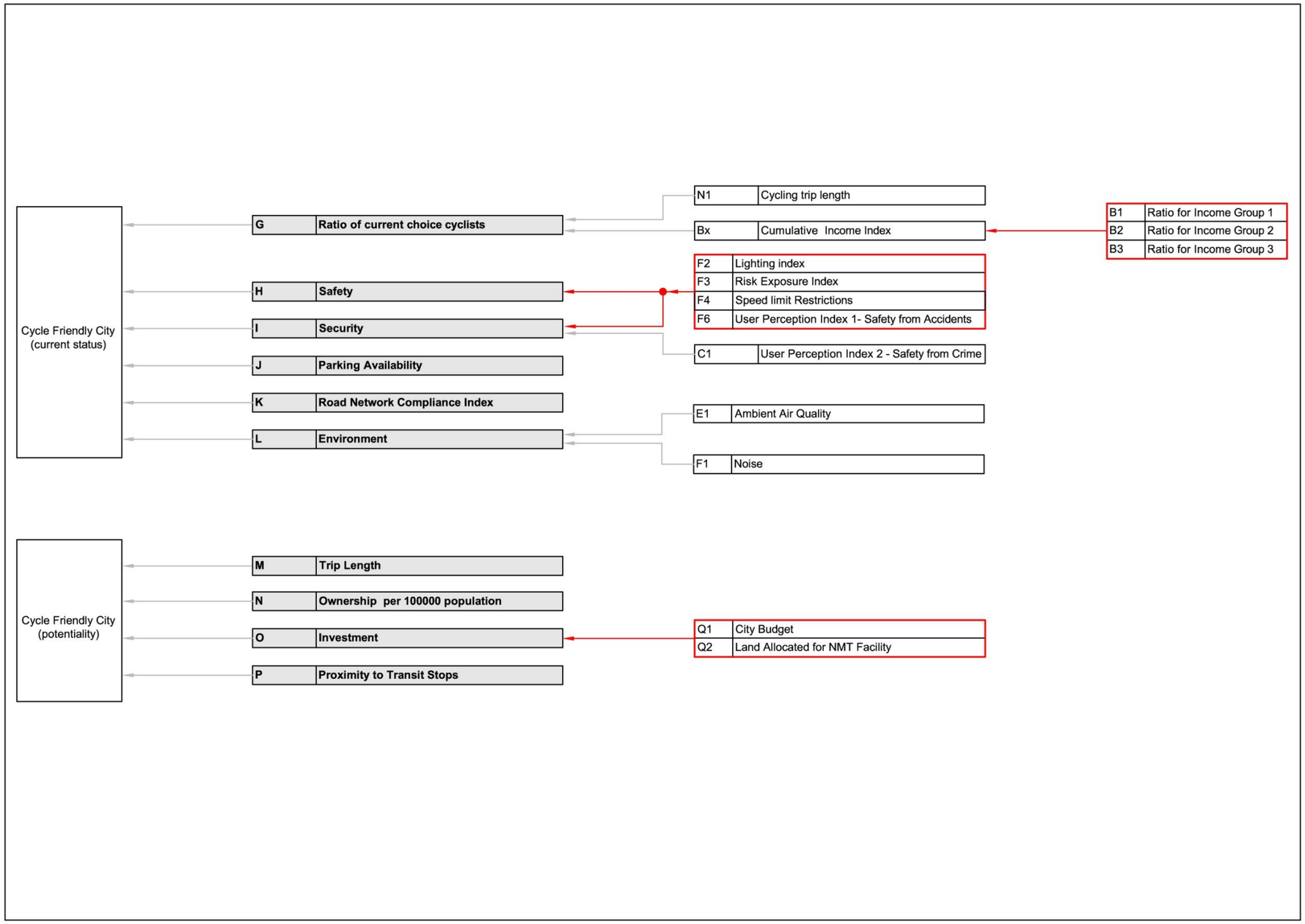


Figure 39: Flow chart showing relationship between Categories, derived indicators and Indicators (City wide cycling Network)

The 10 primary indicators used for the evaluation of City wide cycling network are as follows:

Ratio of current choice cyclist: This indicator addresses which income group is cycling (whether choice commuters are cycling) and how much is the average distance they are travelling by cycle. This indicator includes other sub indicators developed from the input inserted by the user in front end web forms. These sub indicators are as follows:

- Cycling trip length: Indicates the trip length covered by the cyclist in the city.
- Cumulative income index: Indicates the income level of cyclist in the city.

Safety: This indicator addresses how safe the city is in terms of accidents and provision of lighting. This indicator includes other sub indicators developed from the input inserted by the user in front end web forms. These sub indicators are as follows:

- Lighting index: Indicates the level of lighting in the city
- Risk exposure index: Indicates the level of risk posed by the cyclist in the city.
- Speed limit restrictions: Indicates the speed limit of the motor vehicles in the city.
- User perception index-1- Safety from accidents: Indicates the level of safety for the cyclists from accidents in the city.

Security: This indicator addresses how secure the city from street crime. This indicator includes other sub indicators developed from the input inserted by the user in front end web forms. These sub indicators are as follows:

- Lighting index: Indicates the level of lighting in the city in terms of security
- User perception index-2- Safety from crime: Indicates the level of safety for the cyclists from crime in the city.

Parking Availability: This indicator addresses the availability of parking across the city.

Road Network Compliance Index: This indicator addresses if the current road network across all road types is cycling compatible.

Environment: This indicator addresses, how the current environment i.e. ambient air quality and noise pollution of the city affecting the cycling environment. This indicator includes other sub indicators developed from the input inserted by the user in front end web forms. These sub indicators are as follows:

- Ambient air quality: Indicates the air quality level of the city.
- Noise pollution: Indicates the noise pollution level of the city.

Trip Length: This indicator addresses the average distance a cyclist travels across the city.

Ownership per 100000 population: This indicator addresses the bicycle ownership in the city per 100000 population.

Investment: This indicator addresses the investment undertaken in the city for the NMT facilities. This indicator includes other sub indicators developed from the input inserted by the user in front end web forms. These sub indicators are as follows:

- City Budget: Indicates the budget or revenue allotted to the city.
- Land allocated for NMT facility: Addresses land availability designated for NMT facilities in the city.

Proximity to Transit Stops: This indicator addresses the number of households which lie within proximity of transit stops.

7.3.2 Indicators Formulation: City wide cycling network

Assessment for each of the primary indicators as well as the sub-indicators involved in the evaluation process are defined as a formulas, linking inputs from the 'front end' forms (including user and default value forms). These formulas (relationships) are developed for each of the indicator and sub-indicators as shown in **Figure 39** using the assigned codes. The coding process is already been explained in the previous two previous evaluation types under sections (**7.2.2** and **7.2.4**)

8 CyLOS - Evaluation weightages

Weightages indicate relative importance of indicators and indicator categories. They are used to consolidate scores under individual indicators into a single overall score for evaluation, comparison and decision making. Weightages are given and used as percentage values.

8.1.1 Need of weightages

Weightages need to be allocated to each indicator in a category and to the category as a whole.

Indicator weightages: Some indicators are represented in more than one category; here different weightages for the same indicator in different categories may be required. Additionally weightages need to be defined specific to each context. **For example,** infrastructure could be an independent track, on a highway, on an arterial road, on a sub arterial road, on a collector street or on an access road. Each road type presents a different context and hence weightages of indicators between these cannot be the same. All indicators within a category are given percentage weights of the sum total of which is 100 percent. Higher percentage is assigned to indicators with higher relative importance. In that sense percentage weights are representation of an indicators importance in each category.

Category weightages: Similarly percentage weight of each category is representation of the relative importance of that category in the overall cycling infrastructure assessment for a particular road type. **For example,** safety may have a higher weightages for an arterial road, and relatively lower on a collector or an access road.

Therefore, weightages have been assigned separately for indicators and indicator categories.

8.1.2 Evaluation of weightages

The evaluation of each individual indicator, when aggregated with their individual indicator weights provides and overall assessment of each segment/link. Further different individual assessment when aggregated with the assigned category weightages provides an overall assessment of the route. In case of city level evaluation, indicators are directly aggregated with their individual indicator weights to provide an overall assessment of the city.

Weightages for indicators and indicator categories needs to be estimated using expert feedbacks. The weightages assigned in the CyLOS tool are been estimated on the basis of expert reviews undertaken using a questionnaire based survey (to be analysed using AHP method).

For the purpose CyLOS team participated in the NMT workshop organised by TRIPP (IITD).Here presentation on CyLOS tool was conducted for the invited experts. The experts were presented with an AHP based form, to establish relative weightages for the five main indicator categories (Coherence, Directness, Safety, Comfort and Attractiveness) based on the different road

typology (i.e. Arterial road, collector road, local streets and stand alone cycle infrastructure) separately. Based on the feedback collected from these experts on the survey feedback forms relative scoring was fed in AHP matrix to evaluate relative weightages. Geometric mean of the scores from each individual was fed in AHP matrix, to estimate the final weights presented in **Table 3**. A sample of the AHP survey form is presented in **Annexure 10.4.** The same format and the set of the questions were used for each of the road types.

Weightages for the individual indicators within each category has been finalised based on the internal discussion with Dr. Geetam Tiwari from TRIPP, IIT Delhi. These indicator and category weightages have also been included in the NMT Guideline prepared by TRIPP (IIT-Delhi).Current evaluation method in the CyLOS tool uses these weightages assigned as default values. Simultaneously survey forms for evaluation of individual indicators have been designed and distributed to the school children in about 70 schools. Responses from these schools are expected in May 2014, following which the set of the default values will be updated. The survey forms both in English and Hindi versions are presented in (**Annexure10.5 and 10.6**)

Table 3 presents the assumed weightages for each indicator, and for each category under different conditions.

Table 3: Assumed weightages for each indicator and Category under Different conditions

Category	Category Weight				Indicators	Description	Category Specific Indicator Weight				Overall Indicator Weight%			
	Highway, Arterial or Sub arterial	Collector/ Distributory	Access	Standalone/ Independent	Indicators	Description	Highway, Arterial or Sub arterial	Collector/ Distributory	Access	Standalone/ Independent	Highway, Arterial or Sub arterial	Collector/ Distributory	Access	Standalone/ Independent
Coherence	20%	20%	25%	25%	Infrastructure Relevance	How relevant is planned/constructed infrastructure to its context	35%	45%	65%	50%	7.00%	9.00%	16.25%	12.50%
					Frequency of cycle crossings	How frquent are available opportunities for cyclists to cross the road	35%	25%	5%	5%	7.00%	5.00%	1.25%	1.25%
					Cycle Specific Marking	Availability of adequate pavement marking to guide, warn and regulate cyclists	10%	10%	10%	20%	2.00%	2.00%	2.50%	5.00%
					Cycle Specific signage	Availability of adequate sign boards to guide, warn and regulate cyclists	10%	10%	10%	20%	2.00%	2.00%	2.50%	5.00%
					Cycle Box at Intersection	Availability of cycle box marking at intersection to hold crossing cyclists	10%	10%	10%	5%	2.00%	2.00%	2.50%	1.25%
					Total		100%	100%	100%	100%				
Safety	30%	30%	30%	15%	Cycle Box at Intersection	Availability of cycle box marking at intersection to hold crossing cyclists	5%	5%	5%	5%	1.50%	1.50%	1.50%	0.75%
					Crossing Safety Index	What is the level of safety in terms of crash risk and severity, at cyclist crossing facilities	20%	20%	5%	5%	6.00%	6.00%	1.50%	0.75%
					Lighting quality index	What is the quality of lighting in terms of level and uniformity	15%	10%	20%	20%	4.50%	3.00%	6.00%	3.00%
					Mid block accident safety	Assesment of accident risk for cyclist along the carriageway	25%	20%	15%	5%	7.50%	6.00%	4.50%	0.75%
					Eyes on street	Assesment of level of activity along segment, to ensure security	20%	20%	25%	50%	6.00%	6.00%	7.50%	7.50%

					Enforcement	Assessment of level of enforcement to ensure safety on carriageway.	5%	10%	5%	10%	1.50%	3.00%	1.50%	1.50%
					Parking Friction Index	Assessment of risk posed by street parking to commuting cyclists	10%	15%	25%	5%	3.00%	4.50%	7.50%	0.75%
						Total	100%	100%	100%	100%				
Directness	30%	30%	25%	25%	Enforcement	Assessment of level of enforcement to ensure minimal loss of directness to cyclists.	5%	10%	5%	5%	1.50%	3.00%	1.25%	1.25%
					Parking Friction Index	Assessment of loss of directness from friction by street parking to commuting cyclists	8%	25%	20%	5%	2.40%	7.50%	5.00%	1.25%
					Obstruction Index	Assessment of loss of directness casued by presence of abstruction in cycling path	21%	20%	20%	20%	6.30%	6.00%	5.00%	5.00%
					Width Sufficiency Index	Assesment of sufficiency of cycling path width with respect to vehicle size and cycle volume	21%	15%	5%	25%	6.30%	4.50%	1.25%	6.25%
					Hawker Friction Index	Assesment of loss of directness due to friction from hawkers on cycling path	10%	5%	8%	8%	3.00%	1.50%	2.00%	2.00%
					Frequency of punctures	How often is cycling lane/path crossed by vehicular path to access service lane/property entrance, etc.	8%	5%	2%	2%	2.40%	1.50%	0.50%	0.50%
					Pedestrian Friction Index	Assessment of loss of directness due to friction from pedestrians on cycle path	15%	10%	20%	15%	4.50%	3.00%	5.00%	3.75%
					Cyclist Delay at Intersection	Assesment of loss of directness due to delay to cyclists at intersections	4%	4%	6%	6%	1.20%	1.20%	1.50%	1.50%
					Maintenance	Assesment of loss of directness due to friction cause by poor maintenance/ cleaning cycle infrastructure	4%	4%	10%	10%	1.20%	1.20%	2.50%	2.50%
					Turning Radius	Assessment of loss of directness due to tight turning radiuses on cycling path	4%	2%	4%	4%	1.20%	0.60%	1.00%	1.00%

					Total		100%	100%	100%	100%				
Comfort	15%	15%	15%	20%	Turning Radius	Assessment of loss of comfort due to tight turning radii on cycling path	8%	5%	5%	15%	1.20%	0.75%	0.75%	3.00%
					Riding Comfort Index	Assement of riding comfort with reference to surface type	35%	35%	35%	35%	5.25%	5.25%	5.25%	7.00%
					Shaded Length	Assessment of protection from wether in terms of shade/shelter over cycling path	20%	20%	25%	25%	3.00%	3.00%	3.75%	5.00%
					Cross Slope Index	Assessment of water runoff capability and comfortable riding cross slope	7%	5%	3%	3%	1.05%	0.75%	0.45%	0.60%
					Longitudenal Slope Index	Assessment of comfortable riding longitudenal slope	20%	25%	25%	15%	3.00%	3.75%	3.75%	3.00%
					Ramp Slope Index	Assessment of comfort of ramps provide to access egress from cycle path.	5%	5%	2%	2%	0.75%	0.75%	0.30%	0.40%
					Parking Availability Index	Assesment of cycling comfort in terms of availability of safe and secure cycle parking	5%	5%	5%	5%	0.75%	0.75%	0.75%	1.00%
					Total		100%	100%	100%	100%				
Attractiveness	5%	5%	5%	15%	Parking Availability Index	Assesment of cycling comfort in terms of availability of safe and secure cycle parking	25%	20%	10%	5%	1.25%	1.00%	0.50%	0.75%
					Eyes on Street	Attraction of cycling infrastructure in terms of life/ activity along cycling path	20%	20%	25%	40%	1.00%	1.00%	1.25%	6.00%
					Maintenance	Attractiveness of cycling infrastructure in terms of how well it is maintained	40%	40%	40%	30%	2.00%	2.00%	2.00%	4.50%
					Landscaping	Attractiveness of cycling infrastructure in terms of along side landscaping/ plantation	15%	20%	25%	25%	0.75%	1.00%	1.25%	3.75%
Total	100%	100%	100%	100%			100%	100%	100%	100%	100%	100%	100%	100%

The weightages assigned for each indicator and indicator categories according to the evaluation type are presented in the below sections:

8.1.3 Category and indicator weightages assigned in CyLOS tool – For Corridor and transit area evaluation

A total 26 indicators were identified for the evaluation under 5 main categories for corridor and transit area evaluation (**Refer: 7.2.1and 7.2.3**). Some of these indicators contribute to more than one category hence based on the expert's feedbacks the weightages are assigned by the CyLOS tool accordingly for each category and individual indicators contributing to the categories. These are as follows:

1. **Coherence –**Weightages specific to road category is provided such that weightages of all the categories for each road type totals to 100 percent. The weightages assigned are as follows:

- Highway, Arterial, sub arterial – 20%
- Collector , distributary – 20%
- Access – 25%
- Standalone or independent cycle track- 25%

Individual indicator weightages under Coherence Category:

a) **Infrastructure Relevance:** The weightages assigned by the tool for the infrastructure relevance is 35% for Highway, 45% for Collector/Distributor, 65% for Access and 50% for Standalone. The user can modify this. Weightages should be assigned as per the planned or exiting infrastructure along the cycle path, in the overall evaluation.

b) **Frequency of cycle crossings:** The weightages assigned by the tool for the frequency of cycle crossings is 35% for Highway, 25% for Collector/Distributor, 5% for access and 5% for Standalone. The user can modify this. Weightages should be assigned as per the context and available frequent opportunity for cyclist to cross the road, in the overall evaluation.

c) **Cycle specific marking:** The weightages assigned by the tool for the cycle specific marking is 10% for Highway, 10% for Collector/Distributor, 10% for Access and 20% for Standalone. The user can modify this. Weightages should be assigned as per the availability of the adequate pavement marking to guide, warn and regulate cyclists, in the overall evaluation.

d) **Cycle Specific signage:** The weightages assigned by the tool for the frequency of cycle crossings is 10% for Highway, 10% for Collector/Distributor, 10% for Access and 20% for

Standalone. The user can modify this. Weightages should be assigned as per the availability of the adequate sign boards to guide, warn and regulate cyclists, in the overall evaluation.

e) **Cycle Box at intersection:** The weightages assigned by the tool for the frequency of cycle crossings is 10% for Highway, 10% for Collector/Distributor, 10% for Access and 5% for Standalone. The user can modify this. Weightages should be assigned as per the relative importance of the availability of cycle box marking at the intersections to hold the cyclists crossing the road, in the overall evaluation.

2. **Safety –**Weightages specific to road category is provided such that weightages of all the categories for each road totals to 100 percent. The weightages assigned are as follows:

- Highway, Arterial, sub arterial – 30%
- Collector , distributary – 30%
- Access – 30%
- Standalone or independent cycle track- 15%

Individual indicator weightages under Safety Category:

a) **Crossing Safety Index:** The weightages assigned by the tool for crossing safety index is 20% for Highway, 20% for Collector/Distributor, 5% for Access and 5% for Standalone. The user can modify this. Weightages should be assigned as per the level of safety in terms of crash risk and severity at cyclists crossing facilities, in the overall evaluation.

b) **Lighting Quality Index:** The weightages assigned by the tool for the lighting quality index is 15% for Highway, 10% for Collector/Distributor, 20% for Access and 20% for Standalone. The user can modify this. Weightages should be assigned as per the level of lighting quality in terms of lux level and uniformity, in the overall evaluation.

c) **Mid block accident safety:** The weightages assigned by the tool for the mid block accident safety is 25% for Highway, 20% for Collector/Distributor, 15% for Access and 5% for Standalone. The user can modify this. Weightages should be assigned by assessment of accident risk for cyclist along the carriageway, in the overall evaluation.

d) **Eyes on street:** The weightage assigned by the tool for eyes on street is 20% for Highway, 20% for Collector/Distributor, 25% for Access and 50% for Standalone. The user can modify this. Weightage should be assigned by assessment of level of activity along the segment to ensure safety, in the overall evaluation.

e) **Enforcement:** The weightage assigned by the tool for enforcement is 5% for Highway, 10% for Collector/Distributor, 5% for Access and 10% for Standalone. The user can

modify this. Weightage should be assigned by assessment of level of enforcement to ensure safety on carriageway, in the overall evaluation.

f) **Cycle Box at Intersection:** The weightage assigned by the tool for the cycle box at intersection is 5% for Highway, 5% for Collector/Distributor, 5% for Access and 5% for Standalone. The user can modify this. Weightage should be assigned as per the availability of cycle box marking at the intersection to hold crossing cyclist, in the overall evaluation.

g) **Parking friction Index:** The weightage assigned by the tool for the parking friction index is 10% for Highway, 15% for Collector/Distributor, 25% for Access and 5% for Standalone. The user can modify this. Weightage should be assigned by assessment of risk posed by street parking for commuting cyclist, in the overall evaluation.

3. **Directness –** Weightages specific to road category is provided such that weightages of all the categories for each road totals to 100 percent. The weightages assigned are as follows:

- Highway, Arterial, sub arterial – 30%
- Collector , distributary – 30%
- Access – 25%
- Standalone or independent cycle track- 25%

Individual indicator weightages under Directness Category:

a) **Enforcement:** The weightages assigned by the tool for enforcement is 5% for Highway, 10% for Collector/Distributor, 5% for Access and 5% for Standalone. The user can modify this. Weightages should be assigned by assessment of level of enforcement to ensure minimal loss of directness to cyclists, in the overall evaluation.

b) **Parking Friction Index:** The weightages assigned by the tool for the parking friction index is 8% for Highway, 25% for Collector/Distributor, 20% for Access and 5% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness from friction by street parking to commuting cyclists, in the overall evaluation.

c) **Obstruction Index:** The weightage assigned by the tool for the obstruction index is 21% for Highway, 20% for Collector/Distributor, 20% for Access and 20% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness caused by presence of obstructions in the cycling path, in the overall evaluation.

d) **Width Sufficient Index:** The weightage assigned by the tool for width sufficient index is 21% for Highway, 15% for Collector/Distributor, 5% for Access and 25% for Standalone. The user can modify this. Weightage should be assigned by assessment of sufficiency of cycling path width with respect to vehicle size and cycle volume, in the overall evaluation.

e) **Hawker Sufficient Index:** The weightage assigned by the tool for hawker sufficient index is 10% for Highway, 5% for Collector/Distributor, 8% for Access and 8% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness due to friction from hawkers on cycling path, in the overall evaluation.

f) **Frequency of Punctures:** The weightage assigned by the tool for frequency of punctures is 8% for Highway, 5% for Collector/Distributor, 2% for Access and 2% for Standalone. The user can modify this. Weightage should be assigned by assessment of cycling path/ lane crossed by vehicle path to access service lane/ property entrance, in the overall evaluation.

g) **Pedestrian Friction Index:** The weightage assigned by the tool for pedestrian friction index is 15% for Highway, 10% for Collector/Distributor, 20% for Access and 15% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness due to friction from pedestrians on cycling path, in the overall evaluation.

h) **Cyclist delay at Intersection:** The weightage assigned by the tool for cyclist delay at intersection is 4% for Highway, 4% for Collector/Distributor, 6% for Access and 6% for Standalone. The user can modify this. Weightage should be assigned by assessment ofloss of directness due to delay to cyclists at intersections, in the overall evaluation.

i) **Maintenance:** The weightage assigned by the tool for maintenance is 4% for Highway, 4% for Collector/Distributor, 10% for Access and 10% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness due to friction caused by poor maintenance and cleaning of the cycle infrastructure, in the overall evaluation.

j) **Turning radius:** The weightage assigned by the tool for turning radius is 4% for Highway, 2% for Collector/Distributor, 4% for Access and 4% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness due to tight turning radius on the cycling path/ lane, in the overall evaluation.

4. **Comfort –** Weightages specific to road category is provided such that weightages of all the categories for each road totals to 100 percent. The weightages assigned are as follows:

- Highway, Arterial, sub arterial – 15%

- Collector , distributary – 15%
- Access – 15%
- Standalone or independent cycle track- 20%

Individual indicator weightages under comfort Category:

a) **Turning radius:** The weightage assigned by the tool turning radius is 8% for Highway, 5% for Collector/Distributor, 5% for Access and 15% for Standalone. The user can modify this. Weightage should be assigned by assessment of loss of directness due to tight turning radius on the cycling path/ lane, in the overall evaluation.
b) **Riding Comfort Index:** The weightage assigned by the tool for riding comfort index is 35% for Highway, 35% for Collector/Distributor, 35% for Access and 35% for Standalone. The user can modify this. Weightage should be assigned by assessment of riding comfort with reference to surface type, in the overall evaluation.
c) **Shaded Length:** The weightage assigned by the tool for the shaded length is 20% for Highway, 20% for Collector/Distributor, 25% for Access and 25% for Standalone. The user can modify this. Weightage should be assigned by assessment of protection from weather in terms of shade over cycling path, in the overall evaluation.
d) **Cross Slope Index:** The weightage assigned by the tool for the cross slope index is 7% for Highway, 5% for Collector/Distributor, 3% for Access and 3% for Standalone. The user can modify this. Weightage should be assigned by assessment of water runoff capability and comfortable riding cross slope, in the overall evaluation.
e) **Longitudinal Slope Index:** The weightage assigned by the tool for longitudinal slope index is 20% for Highway, 25% for Collector/Distributor, 25% for Access and 15% for Standalone. The user can modify this. Weightage should be assigned by assessment of comfortable riding along the longitudinal slope, in the overall evaluation.
f) **Ramp Slope Index:** The weightage assigned by the tool for ramp slope index is 5% for Highway, 5% for Collector/Distributor, 2% for Access and 2% for Standalone. The user can modify this. Weightage should be assigned by assessment of comfort of ramp provided to access the egress from the cycle path, in the overall evaluation.
g) **Parking Availability Index:** The weightage assigned by the tool for ramp slope index is 5% for Highway, 5% for Collector/Distributor, 5% for Access and 5% for Standalone. The user can modify this. Weightage should be assigned by assessment of cycling comfort in terms of availability of safe and secure cycle parking, in the overall evaluation.

5. **Attractiveness –** Weightages specific to road category is provided such that weightages of all the categories for each road totals to 100 percent. The weightages assigned are as follows:

- Highway, Arterial, sub arterial – 5%
- Collector , Distributary – 5%
- Access – 5%
- Standalone or independent cycle track- 15%

Individual indicator weightages under Attractiveness Category:

a) **Parking Availability Index:** The weightages assigned by the tool for parking availability index is 25% for Highway, 20% for Collector/Distributor, 10% for Access and 5% for Standalone. The user can modify this. Weightages should be assigned by assessment of cycling comfort in terms of availability of safe and secure cycle parking, in the overall evaluation.
b) **Eyes on street:** The weightages assigned by the tool for eyes on street is 20% for Highway, 20% for Collector/Distributor, 25% for Access and 40% for Standalone. The user can modify this. Weightages should be assigned by assessment of attraction of cycling infrastructure in terms of level of activity along the cycle path, in the overall evaluation.
c) **Maintenance:** The weightages assigned by the tool for maintenance is 40% for Highway, 40% for Collector/Distributor, 40% for Access and 30% for Standalone. The user can modify this. Weightages should be assigned by assessment of attractiveness of cycling infrastructure in terms of its maintenance and cleanliness, in the overall evaluation.
d) **Landscaping:** The weightage assigned by the tool for landscaping is 15% for Highway, 20% for Collector/Distributor, 25% for Access and 25% for Standalone. The user can modify this. Weightages should be assigned by assessment of attractiveness of cycling infrastructure in terms of landscaping and plantation along the cycle path, in the overall evaluation.

8.1.4 Category and indicator weightages assigned in CyLOS tool – For City level evaluation

A total 10 indicators were identified for the evaluation under 2 categories for city level evaluation (**Refer: 7.3.1**). Hence based on the expert's feedbacks the weightages are assigned by the CyLOS tool for each individual indicators contributing to the categories .These are as follows:

1. **Ratio of commuting choice cyclists**: The weightage assigned by the tool is 15% for this indicator,
   Individual sub -indicator weightages under Ratio of commuting choice cyclists are as follows:

a) **Cycling Trip length**: The default weightage provided in the tool is 40%. This indicator has three input values and individual weightage for each is provided

- **For Trips less than 1 km**: The default weightage provided in the tool is 10%.
- **For trips between 1 and 5 km**: The default weightage provided in the tool is 60%.
- **For trips between 5km and 10 km**: The default weightage provided in the tool is 30%.

b) **Cumulative Income Index**: The default weightage provided in the tool is 60%. This indicator has three input values and individual weightage for each is provided

- **For <15000 per month**: The default weightage provided in the tool is 10%.
- **More than 15000 per month and less than equal to 35000 per month**: The default weightage provided in the tool is 60%.
- **More than 35000 per month**: The default weightage provided in the tool is 30%.

2. **Safety**: The weightage assigned by the tool is 15%.
   Individual sub -indicator weightages under safety are as follows:

a) **Lighting Index:** The default weightage provided in the tool is 40%.
b) **Risk Exposure Index:** The default weightage provided in the tool is 30%.
c) **Speed Limit Restrictions**: The default weightage provided in the tool is 20%.
d) **User Perception Index – Safety from accidents**: The default weightage provided in the tool is 10%.

3. **Security**: The weightage assigned by the tool is 15%.
   Individual sub -indicator weightages under Security are as follows:

a) **Lighting Index:** The default weightage provided in the tool is 80%.
b) **User Perception Index – Security from Crime:** The default weightage provided in the tool is 20%.

4. **Parking availability**: The weightage assigned by the tool is 15%.
5. **Road network compatibility index**: The weightage assigned by the tool is 15%.
6. **Environment**: The weightage assigned by the tool is 15%.
   Individual sub -indicator weightages under environment are as follows:

a) **Ambient Air Quality : The** default weightage provided in the tool is 84%. This indicator has four inputs values and individual weightage for each is provided.

- **NOx**: The default weightage provided in the tool is 25%.
- **SO2**: The default weightage provided in the tool is 25%.
- **PM_{10}**: The default weightage provided in the tool is 25%.
- **$PM_{2.5}$**: The default weightage provided in the tool is 25%.

b) **Noise:** The default weightage provided in the tool is 16%.

7. **Trip Length**: The weightage assigned by the tool is 50%.
8. **Ownership**: The weightage assigned by the tool is 20%.
9. **Investment**: The weightage assigned by the tool is 20%.
   Individual sub -indicator weightages under investment are as follows:

a) **City Budgets:** The default weightage provided in the tool is 40%.
b) **% of land allocated to NMT Facilities:** The default weightage provided in the tool is 60%.

10. **Proximity to Transit stops**: The weightage assigned by the tool is 10%.

9 Way Forward

The next step is to conduct workshops in the cities explaining the use of tool and its implementation. This aim of the workshops will be to gather information and feedback from different stakeholders on the indicators used in the tool. The idea is to spread awareness in different cities about the tool and manual. The website developed for the tool, *www.cylos.in* will also be introduced during the workshops along with the detail manual to the different stakeholders. This will help in getting feedback on the user friendliness of the tool and manual. The feedback received from different stakeholders and government officials will be further analysed and modifications will be done in the tool based on that.

10 Annexure

10.1 Annexure 1 – Components used in derived indicators – Corridor/ route evaluation type.

Codes	Indicator	Components used in the formulas
A	Total Number of Crossings	Safe/Traffic calmed crossing no., number of unsignalized/unsafe crossing ,number of major crossing, additional grade separated cycle crossings in the segment- foot over bridges and subways, % of Cycle crossing to be considered at grade separated- indicators contributing to the estimated total number of crossings
B	Total Frequency of Crossing	length of segment, total number of crossings- indicators contributing to the estimated Total Frequency of Crossing
C	Number of Unsignalized /Unsafe Crossing	% length divided, length of segment, Major Junction width, Number of major crossings, safe/Traffic calmed crossing no., Minor Crossing width- indicators contributing to the estimated Number of Unsignalized/Unsafe Crossing
D	Total number of Safe Crossings	Number of major safe crossings, safe/Traffic calmed crossing no- indicators contributing to the estimated Total number of Safe Crossings
E	Total Frequency of Safe Crossings	length of segment, total number of safe crossings- indicators contributing to the estimated Total Frequency of Safe Crossings
F	Total Frequency of unsignalized Crossings	length of segment, number of unsignalised/unsafe crossings- indicators contributing to the estimated Total Frequency of unsignalized Crossings
G	Crossing Intensity	PHPDT Crossing Attraction, Weighted Average of Land use
I	Effective Width	Min.width, total shy away width, number of lanes, lane width of carriage way- indicators contributing to the estimated Effective Width
J	Safety Index of Crossing	crossing exposure index, crossing intensity, total number of safe crossing, total number of crossing, total traffic calming index- intersections and crossings- indicators contributing to the estimated Safety Index of Crossing
K	Number of Major Crossings	no provision for crossing/ physically prevented from crossing, number of major junctions- indicators contributing to the estimated number of major crossings
L1	Shy away Width Left Side	peak hour traffic data in PHPD- bicycle, passenger rickshaw, goods rickshaw, primary adjacent vertical heights(left), shy away width- wall, vertical structures- indicators contributing to the estimated Shy away Width Left Side
L2	Shy away Width Right Side	peak hour traffic data in PHPD- bicycle, passenger rickshaw, goods rickshaw, primary adjacent vertical heights(right), shy away width- wall, vertical structures- indicators contributing to the estimated Shy away Width Right Side

L3	Total Shy away Width	shy away width left side, shy away width right side- indicators contributing to the estimated Total Shy away Width
M	Number of Major Safe Crossings	number of major junctions, traffic calming used at intersection, unsignalized junction, % of Cycle crossing to be considered at grade separated, primary cyclist crossing type across the road(overpass or underpass)- indicators contributing to the estimated Number of Major Safe Crossings
N	Crossing Exposure Index	vehicular speed safety index, exposure to MV lanes index, Weighted avg. exposure to MV lane- indicators contributing to the estimated Crossing Exposure Index
O	Shaded Length	Shading length Index, % length shaded- indicators contributing to the estimated Shaded Length
P	Vehicular Speed	posted speed limits, observed peak speeds- indicators contributing to the estimated Vehicular Speed
Q	Total PBU	peak hour traffic data- bicycle, passenger rickshaw, goods rickshaw, Passenger Bicycle unit- bicycle, bicycle with goods, passenger rickshaw, goods rickshaw, breakup of captive bicycle user share(as % of total captive users)- indicators contributing to the estimated Total PBU
R	Frequency of Puncture Index	Frequency of Punctures, length of midblock, number of cycle lane puncture- indicators contributing to the estimated Frequency of Puncture Index
S	Number of Cycle Lane Puncture	service lane %, number of minor junctions, number of property entrances, length of midblock, Frequency of punctures on service lane- indicators contributing to the estimated Number of Cycle Lane Puncture
T	Friction from Pedestrian Index	infrastructure design at mid block- segregated track, painted lanes, unsegregated, common with footpath- indicators contributing to the estimated Friction from Pedestrian Index
U	Pedestrian Density Index	Space allocation per pedestrian, availability as percentage of total segment length- footpath %, length of segment, Footpath width, pedestrian speed- indicators contributing to the estimated Pedestrian Density Index
V	Parking Friction Index	infrastructure design at mid block- segregated track, painted lanes, unsegregated, common with footpath, infrastructure location-cycle track or segregated, Between street parking and carriage way and angled parking, primary location of track/lane on cross section- between on street parking and carriage way, private vehicles on street parking numbers along the segment, parallel parking, Parking length- indicators contributing to the estimated Parking Friction Index
X	Relivence Index	XA, XB, XC, XD, Cycle track height index, Intersection relevence, Intersection boundry, Primary cyclist crossing type across free left turns or segregated left turn lanes, Cycle track height index, Cyclist approach / access to intersection- - indicators contributing to the estimated relivence index

XA		Primary segregation type from carriageway-raised median, green belt, open drain, location of bus stop- no bus station on curbside, bus stop in between cycle track and carriageway, street category and speeds- highway, arterial, sub-arterial, primary location of track/lane on cross section-along carriageway, segregated tracks, segregation width- indicators contributing to the estimated XA
XB		street category and speeds- collector/distributory, location of bus stop- no bus station on curbside, bus stop in between cycle track and carriageway, carriageway traffic(along segment)-LHS and R.H.S, one way, primary segregation type from carriageway- not segregated, paint marking, raised median, green belt, open drain, segregation width, primary location of lane/track on cross section-along carriageway, segregated tracks, parallel parking, independent parking, no parking, carriageway traffic- one way- indicators contributing to the estimated XB
XC		street category and speeds- access, painted lanes, primary location of track/lane on cross section- along carriageway, unsegregated- indicators contributing to the estimated XC
XD		street category and speeds- independent track/facility, primary segregation type from carriageway- not along carriageway, primary location of track/lane on cross section-independent or standalone, common with footpath- indicators contributing to the estimated XD
Z	Riding Comfort Index	riding comfort index, primary surface type- asphalt, concrete, smooth tiled, rough finish paver blocks, conc. Slabs- indicators contributing to the estimated Riding Comfort Index
A1	Service Lane %	street category and speeds- highway, arterial, sub arterial, service lane, service quality index- indicators contributing to the estimated Service Lane %
B1	Footpath % Index	% of footpath- indicators contributing to the estimated Footpath % Index
C1	Parking Length	angled parking, parallel parking, independent path, private vehicle on street parking numbers along segment(PCU), parallel parking length- indicators contributing to the estimated Parking Length
C2	Parking Length(IPT parking)	IPT parking bays provided, IPT parking bays number, IPT standard width- indicators contributing to the estimated Parking Length(IPT parking)
C3	Percentage of parking over the segment	parking length(private vehicles), parking length(IPT), length of midblock- indicators contributing to the estimated Percentage of parking over the segment
D1	Hawking Friction Index	Hawking Friction Index, frequency of hawkers- indicators contributing to the estimated Hawking Friction Index
E1	Frequency of Hawkers	length of midblock, hawking zones provided, number of hawkers, Friction caused by hawkers- hawking zones provided,

		hawking zones not provided- indicators contributing to the estimated Frequency of Hawkers
F1	Vehicular Speed Safety Index	Vehicular speed safety Index- indicators contributing to the estimated Vehicular Speed Safety Index
G1	Exposure to MV Lanes Index	Exposure to MV lane Index, primary cyclist crossing type across intersecting roads- crossing with or without marking, raised crossing, signalized with or without raised crossing, grade separated(overpass or underpass), no provision for crossing/physically prevented from crossing, carriageway traffic along segment- number of lanes per direction- indicators contributing to the estimated Exposure to MV Lanes Index
H1	PHPDT Crossing Attraction Index	total number of cyclist, total number of cyclist PHPD- indicators contributing to the estimated PHPDT Crossing Attraction Index
J1	Turning Radius Index (MIDBLOCK)	Turning Radius, minimum turning radius for cyclist- indicators contributing to the estimated Turning Radius Index (MIDBLOCK)
K1	Obstruction Index (MIDBLOCK)	Infrastructure type- Painted lanes, unsegregated, right angled parking, parallel parking, street parking, Frequency of Obstruction, Parallel parking over cycle lane/ unsegregated/bus stop on the cycle track, Angled parking over cycle lane/ unsegregated indicators contributing to the estimated Obstruction Index (MIDBLOCK)
LL1	Cross Slope Gradient Index (MIDBLOCK)	cross slope gradient index(Intersections / midblocks), slopes and gradients- minimum cross slope gradient- indicators contributing to the estimated Cross Slope Gradient Index (MIDBLOCK)
M1	Longitudinal Slope Index(MIDBLOCK)	Long. slope gradient index(Intersections / midblock), slopes and gradients- max. gradient or longitudinal slopes(>3m length)- indicators contributing to the estimated Longitudinal Slope Index(MIDBLOCK)
N1	Ramp Slope Gradient(MIDBLOCK)	average ramp slopes used for level changes, Ramp. slope gradient index(Intersections / midblock)- indicators contributing to the estimated Ramp Slope Gradient(MIDBLOCK)
O1	Lighting Levels	lighting levels measured on cyclist path-designed/observed average lighting levels, street category and speeds-independent track/facility, highway, arterial, sub arterial collector/distribuitory, access, Light levels at intersections and midblock- indicators contributing to the estimated Lighting Levels
P1	Lighting Uniformity	lighting levels measured on cyclist path-designed/observed average lighting uniformity, street category and speeds-independent track/facility, highway, arterial, sub arterial collector/distribuitory, access, Light Uniformity at Intersections and midblock- indicators contributing to the estimated Lighting Uniformity
Q1	Cycle Specific Marking-Major junctions	presence of cycle specific signage and markings- indicators contributing to the estimated Cycle Specific Marking- Major junctions

R1	Cycle Specific Signage- Major Junctions	presence of cycle specific signage and markings- indicators contributing to the estimated Cycle Specific Signage- Major Junctions
S1	Cyclist Delay At Intersection	Intersection delay, average cyclist delay, Cyclist delay at intersections, Infrastructure relevance and continuity index, Cycle infrastructure continuity, Cyclist approach / access to intersection - indicators contributing to the estimated Cyclist Delay At Intersection
T1	Traffic Calming at Intersection Index	traffic calming used at intersection- indicators contributing to the estimated Traffic Calming at Intersection Index
U1	Cycle Box at Intersection Index	demarcated cycle stacking spaces such as bike boxes provided- indicators contributing to the estimated Cycle Box at Intersection Index
V1	Traffic Calming other than intersection	primary cyclist crossing type across intersecting roads- traffic calmed- indicators contributing to the estimated Traffic Calming other than intersection
X1	Lighting Levels at Intersection	average lighting levels, street category and speeds- independent track/facility, highway, arterial, sub arterial, collector/distributory, access, Light levels at intersections and midblock- indicators contributing to the estimated Lighting Levels at Intersection
Y1	Lighting Uniformity at Intersection	average lighting uniformity, street category and speeds- independent track/facility, highway, arterial, sub arterial, collector/distributory, access, lighting levels measured on cyclist path-designed/observed average lighting uniformity, Light Uniformity at Intersections and midblock- indicators contributing to the estimated Lighting Uniformity at Intersection
A4	Lighting Quality Index Midblock	lighting levels(midblock) + lighting uniformity(midblock)- indicators contributing to the estimated Lighting Quality Index Midblock
B4	Lighting Quality Index Intersection	lighting levels(intersection) + lighting uniformity(intersection)- indicators contributing to the estimated Lighting Quality Index Intersection
C4	Overall Lighting Quality Index	lighting quality index(midblock), length of midblock, length of segment, lighting quality index(intersection)- indicators contributing to the estimated Overall Lighting Quality Index
Z1	Total No. of Cyclists	peak hour traffic data in PHPD- bicycle, passenger rickshaw, goods rickshaw- indicators contributing to the estimated Total No. of Cyclists
A2	Weigted Average of Landuse	Land use(both sides)- Com. Ret Facing Com.Ret, Com.Ret Facing Resi/ Office, Com.Ret facing others, Resi/ off facing Resi /off, Resi/ off facing Others, Others facing others- indicators contributing to the estimated Weighted Average of Landuse
G2	Trasit Station NMV PARKING	% of transit stations covered with parking(within 100 m), Parking at transit stations - indicators contributing to the estimated Trasit Station NMV PARKING

J2	Cycle Parking	% of commercial/inst. Landuse served by parking(within 100m), % of Cycle parking- indicators contributing to the estimated Cycle Parking
I2	Over all parking availability index	transit station NMV parking, % of transit stations covered with parking(within 100 m), % of commercial/inst. Land use served by parking(within 100m), parking land use, usability of cycle parking- indicators contributing to the estimated Over all parking availability index
M2	Maintenance	Maintenance- entirely clean, well maintained and free from debris, partly clean but mostly free from debris and/or with minor maintenance requirement, mostly covered with debris and/or in need of urgent repairs along majority length- indicators contributing to Maintenance
N2	Landscaping	landscaping- periphery/edges include designed green cover, street furniture and varied façade, periphery/edges partly or fully include green cover but lacks interesting façade and/or street furniture along majority length, lack of designed green cover and other landscaping elements and/or has long monotonous facades along majority length- indicators contributing to the estimated Landscaping
O2	Enforcement	Enforcement, well enforced-no encroachment by motorists and parking along the entire segment length, partly enforced-light motor vehicles encroach designated cycle infrastructure near intersections but no parking and no encroachment at mid block, lack enforcement- motor vehicles routinely encroach and park on designated infrastructure- indicators contributing to enforcement
P2	Usability of cycle track facility	evaluation type- evaluation of existing infrastructure or facility, additional information for existing segment/route- in case designated cycle track or lane indicate average % of cyclists using facility along segment- indicators contributing to the estimated Usability of cycle track facility
R2	Usability of cycle parking	evaluation type- evaluation of existing infrastructure or facility, in case of designated cycle or rickshaw parking indicate average % of cyclists using facility along segment- indicators contributing to the estimated Usability of cycle parking
S2	Cycle marking - midblock	marking and signage- presence of cycle specific marking (excluding lanes)- indicators contributing to the estimated Cycle marking - midblock
T2	Cycle signage - midblock	marking and signage- presence of cycle specific sign boards- indicators contributing to the estimated Cycle signage - midblock
U2	Overall cycle marking	cycle specific marking(major junctions), cycle marking(midblock)- indicators contributing to the estimated Overall cycle marking
V2	Overall cycle signage	cycle signage(midblock), cycle specific signage(major junctions)- indicators contributing to the estimated Overall cycle signage

W2	PBU per effective lane	cycle signage(midblock), cycle specific signage(major junctions)- indicators contributing to the estimated Overall cycle signage
X2	Width sufficiency Index	infrastructure type-segregated tracks, painted lanes, unsegregated, NMV width requirement, NMV width requirement(segregated tracks), NMV volume requirement per lane, NMV width requirement(painted lanes), NMV width requirement index(common), width requirement index for common cycle track and footpath(based on volume)- indicators contributing to the estimated Width sufficiency Index
E4	NMV width requirement (segregated tracks)	infrastructure design at midblock-minimum width, NMV track width segregated- indicators contributing to the estimated NMV width requirement (segregated tracks)
H4	NMV volume requirement	PBU per effective lane, NMV Volume/lane- indicators contributing to the estimated NMV volume requirement
I4	NMV width requirement (painted lane)	infrastructure design at mid block-minimum width, NMV lane width (painted)- indicators contributing to the estimated NMV width requirement (painted lane)
J4	Width requirement index for common cycle track footpath(based on measurement)	infrastructure design at mid block-minimum width, NMV track width requirement index(common)(based on measurement)- indicators contributing to the estimated Width requirement index for common cycle track footpath(based on measurement)
K4	Frequency of obstructions midblock	length of midblock, number of obstruction on bicycle path- indicators contributing to the estimated Frequency of obstructions midblock
L4	Length of Midblock	Infrastructure Type, length of segment, number of major intersections, Major Junction width- indicators contributing to the estimated Length of Midblock
M4	Midblock Accident safety Index	evaluation type- evaluation of existing infrastructure, midblock risk index, estimated midblock risk, Midblock accident safety index, Side edge drop index- indicators contributing to the estimated Midblock Accident safety Index
N4	Eyes on street (% of Segment which has activity(Hawkers))	frequency of hawkers, % of Segment which has activity(Hawkers)- indicators contributing to the estimated Eyes on street (% of Segment which has activity(Hawkers))
O4	Current Fatalities	indicate the average annual number of cyclist fatalities along the segment, Fatalities- indicators contributing to the estimated Current Fatalities
P4	Frequency of crossing index	street category and speeds-independent track/facility, highway, arterial, sub-arterial, collector/distributory, access, Crossing frequency- indicators contributing to the estimated Frequency of crossing index
Q4	Total traffic calming index - Intersections & Crossings	primary intersection type- unsignalized junction, signalized junction, one lane roundabout, two lane roundabout, rotary, grade separated(for vehicles), traffic calming at intersection index, traffic calming at midblock index, % of Cycle crossing to be considered at grade separated- indicators contributing to the estimated Total traffic calming index - Intersections &

		Crossings
S4	Midblock risk index	fatalities/segment length, Midblock Risk Index- indicators contributing to the estimated Midblock risk index
T4	Estimated midblock risk	vehicular speed, primary segregation type from carriageway-paint marking, reflector studs, Estimated Midblock Risk, Cycle infrastructure continuity- indicators contributing to the estimated midblock risk
U4	Fatalities/ segment length	current fatalities, length of segment- indicators contributing to the estimated Fatalities/ segment length
W4	Width requirement index for common cycle track and footpath(based on volume)	infrastructure type- minimum width, width requirement for common cycle track footpath- indicators contributing to the estimated Width requirement index for common cycle track and footpath(based on volume)
PLI	Parking Length Index	percentage of parking over the segment, parking length- indicators contributing to the estimated Parking Length Index
W4-1	Width requirement for common cycle track footpath	peak hour traffic data in PHPD- pedestrians, number of bicycle, pedestrian speed, Effective Lane width- indicators contributing to the estimated Width requirement for common cycle track footpath
W4-2	Width requirement for common cycle track footpath	peak hour traffic data in PHPD- pedestrians, number of bicycle, pedestrian speed, Effective Lane width- indicators contributing to the estimated Width requirement for common cycle track footpath
W4-3	Width requirement for common cycle track footpath	peak hour traffic data in PHPD- pedestrians, number of bicycle, pedestrian speed, Effective Lane width- indicators contributing to the estimated Width requirement for common cycle track footpath
W4-4	Width requirement for common cycle track footpath	peak hour traffic data in PHPD- pedestrians, number of bicycle, pedestrian speed, Effective Lane width- indicators contributing to the estimated Width requirement for common cycle track footpath
W4-5	Width requirement for common cycle track footpath	peak hour traffic data in PHPD- pedestrians, number of bicycle, pedestrian speed, Effective Lane width- indicators contributing to the estimated Width requirement for common cycle track footpath
SQI	service lane quality index	availability as percentage of total segment length- service lane %, quality in terms of percentage of service lane and footpath meeting different grades-Service lane- % of A, % of B- indicators contributing to the estimated service lane quality index
FQI	footpath quality index	availability as percentage of total segment length- footpath %, quality in terms of percentage of service lane and footpath meeting different grades-Service lane-footpath- % of A, % of B- indicators contributing to the estimated footpath quality index

CIC	Cycle infrastructure continuity index	Cycle infrastructure continuity at minor junctions, Cycle infrastructure continuity at property entrances
B5	Blinkers and signages at Minor junction	Provision of warning such as blinkers and signboards
SS1	Cycle path width reduction at intersection approach(more than 0.3 m)	Width of cycle track / lane reduction (by more than 0.3m) on approaching to the junction
SS2	Cyclist approach / access to intersection	Cyclist Approach/access at the Intersection- segregated, cycle lane, unsegregated, common, stand alone, Street Category and Speeds- collector road, access road, Infrastructure Type- segregated tracks, painted lanes, unsegregated ,common with footpath
XI	Intersection relevance	Street Category and Speeds- independent track, highway, arterial, sub arterial, collector, access, Primary intersection type- signalized junction, unsignalized junction, one lane round about, two lane round about, rotary, grade separated(for vehicles)
IBI	Intersection boundary	Street category and speeds- highway, arterial, sub-arterial, collector, primary cycle infrastructure along intersection boundary- painted marking on the periphery along circular road, no segregation/demarcation- common with carriageway
PCCT	Primary cyclist crossing type across free left turns or segregated left turn lanes	street categories and speeds- independent track, arterial, collector, distributory, Primary cyclist crossing type across free left turns or segregated left turn lanes- crossing marked across carriageway, raised crossing, grade separated(underpass or overpass), signalized crossing
PCI	Parking cost index	Parking cost rupees per day
CHI	Cycle track height index	street category and speeds- independent track, Average height above/below road surface (main carriageway)
SED	Side edge drop	Primary adjacent vertical edge heights
SEDI	Side edge drop index	Side edge drop
CICM	Cycle infrastructure continuity at minor junctions	Infrastructure Type-segregated tracks, painted lanes,unsegregated, common with footpath, Primary type of crossing for cyclists across vehicular path- at carriageway level,

		level of cycle track remains same(above carriageway), at footpath level
CICP	Cycle infrastructure continuity at property entrances	Infrastructure design at mid block- Segregated tracks, painted lanes, unsegregated, common with footpath, Primary type of crossing for cyclists across vehicular path- at carriageway level, level of cycle track remains same(above carriageway), at footpath level

10.2 Annexure 2 – Components used in derived indicators -Transit access area evaluation type.

Codes	Indicator	Components used in formula
P4	Accessibility index	Street category and speeds-independent track/facility, highway, arterial, sub-arterial, collector/distributory, access, Crossing frequency- indicators contributing to the estimated Frequency of crossing index
Y4	Link density	Number of links, Accessibility influence zone radius
Y3	Link density index	Link density

10.3 Annexure 3 – List of the participants (NMT workshop)

Participants Name	From
Dr. Geetam Tiwari	IIT - DELHI
Miss Aloke Parna	IIT - DELHI
Miss Leeza Malik	IIT - DELHI
Mr.Ravi Gadepalli	Shakti Foundation
Mr.Ranjit Gadgil	Parisar
Dr. Joseph Fazio	Fazio Engineerware
Prof.Girish aggarwal	IIT - DELHI
Miss Ruchi Varma	SGArchitects
Mr. Nilesh Bansal	SGArchitects
Mr. Parvesh sherawat	I-Trans
Mr.Sandeep Gandhi	SGArchitects

10.4 Annexure 4 – Feed Back forms (NMT workshop)

AHP forms for road infrastructure type are as follows:

S. No. 1	Surveyor: Sandeep Respondent: Leeza Malik	Date: 17/12/13
S. No.	Which one of the two is preferred? By how much?	Score
	Coherence, or the degree to which the cycling infrastructure is legible to cyclist, is continuous, integrated and networked	
1	Directness, or the measure impacting the the travel time and speed of cyclist	
	Coherence, or the degree to which the cycling infrastructure is legible to cyclist, is continuous, integrated and networked	
2	Safety, or the measure of infrastructures ability to protect the cyclist from crashes/accidents and crime	
	Coherence, or the degree to which the cycling infrastructure is legible to cyclist, is continuous, integrated and networked	
3	Comfort, or the ability of the infrastructure to ensure a comfortable ride for cyclists in terms of surface quality and protection from environment	
	Coherence, or the degree to which the cycling infrastructure is legible to cyclist, is continuous, integrated and networked	
4	Attractiveness, or the the property of the infrastructure to provide a visually and physically pleasing environment for cycling	
	Directness, or the measure impacting the the travel time and speed of cyclist	
5	Safety, or the measure of infrastructures ability to protect the cyclist from crashes/accidents and crime	
	Directness, or the measure impacting the the travel time and speed of cyclist	
6	Comfort, or the ability of the infrastructure to ensure a comfortable ride for cyclists in terms of surface quality and protection from environment	
	Directness, or the measure impacting the the travel time and speed of cyclist	
7	Attractiveness, or the the property of the infrastructure to provide a visually and physically pleasing environment for cycling	
	Safety, or the measure of infrastructures ability to protect the cyclist from crashes/accidents and crime	
8	Comfort, or the ability of the infrastructure to ensure a comfortable ride for cyclists in terms of surface quality and protection from environment	
	Safety, or the measure of infrastructures ability to protect the cyclist from crashes/accidents and crime	
9	Attractiveness, or the the property of the infrastructure to provide a visually and physically pleasing environment for cycling	
	Comfort, or the ability of the infrastructure to ensure a comfortable ride for cyclists in terms of surface quality and protection from environment	
10	Attractiveness, or the the property of the infrastructure to provide a visually and physically pleasing environment for cycling	

10.5 Annexure 5 – Survey Form for School Children – English Version

CyLOS, Cycling Level of Service Tool, 2014

CyLOS is a tool that helps planners and designers to plan and develop safe and convenient cycling paths and facilities. Such cycling infrastructure will be useful for short commutes within the city, including trips to school, to local shops, work places, etc. The following questionnaire shall assist in enhancing the performance of the tool. You are requested to fill in the basic details on this page, and select a road type which best resembles the road that you may be using to reach the school (tick against one image). In the subsequent forms, please select one of the two given features (in each row) that you prefer. To rate your preference level of one feature over the other, please input a score (1 to 9), where 1 means that both features are equally preferred and 9 means that the selected feature is extremely preferred over the other.

Name	AMIT SHARMA	Age	16	Gender (M/F)	M
Class	10			Section	A
School	Sarthak Senior Secondary School			City	Lucknow

How do you come to school? (TICK (√) ONE)									
Walk	Cycle	Auto ✓	Cycle Rickshaw	Bus	Van	Car	Scooter/Motor Cycle	Others (Specify)	

What type of road is connecting your home to school?		TICK (√) ONE
MAJOR ROAD, WITH HIGH SPEED MOTOR VEHICLES		
NOT VERY WIDE, MAIN ROAD WITH FEW CARS AND TWO WHEELERS		✓
NARROW ROAD WITH SHOPS OR HOUSES ON BOTH SIDES, LESS CARS, MORE PEOPLE		
NO ROAD - PATHS OR LANES GOING THROUGH PARK OR OTHER OPEN AREAS		

Please Courier/post forms to: SGArchitects, 6151/8, Sector D, Pocket 6, Vasant Kunj, New Delhi – 110070
Email: design@sgarchitects.in, Tel: 011-42147521, web – www.sgarchitects.in

CyLOS, Cycling Level of Service Tool, 2014

PREFERENCE SCORE	
Equally Preferred	1
Moderately Preferred	3
Strongly Preferred	5
Very Strongly Preferred	7
Extremely Preferred	9

EXAMPLE		
WHAT DO YOU PREFER? (CHOOSE ONE and TICK MARK IN THE BOX GIVEN)		SCORE - BY HOW MUCH do you prefer apple over orange?
APPLE	ORANGE ✓	7

What features in a proposed cycling facility do you prefer for cycling to/from school?

Tick mark the preference between features (each row) and add a preference score for the selected

	SELECT ROAD TYPE	ARTERIAL / COLLECTOR / ACCESS / STANDALONE	SCORE
	DIRECTNESS		
1	Prevention from car/scooter parking along your cycling path ✓	Prevention from other vehicles using your cycling path	9
2	Prevention from car/scooter parking along your cycling path	Removal of obstruction like poles, potholes, broken surface, etc from your cycling path ✓	5
3	Prevention from car/scooter parking along your cycling path ✓	Adequate width of your cycling path	5
4	Prevention from car/scooter parking along your cycling path	Prevention of hawkers/street vendors standing in your cycling path ✓	7
5	Prevention from car/scooter parking along your cycling path ✓	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	3
6	Prevention from car/scooter parking along your cycling path ✓	Preventing pedestrians walking on your cycling path?	3
7	Prevention from car/scooter parking along your cycling path	Less waiting time at red light ✓	7
8	Prevention from car/scooter parking along your cycling path ✓	Cycle path which is clean,well-maintained, free from	3
9	Prevention from car/scooter parking along your cycling path ✓	Smooth turnings which does not reduce your speed	3
10	Prevention from other vehicles using your cycling path ✓	Removal of obstruction like poles, potholes, broken surface, etc	7
11	Prevention from other vehicles using your cycling path ✓	Adequate width of your cycling path	7
12	Prevention from other vehicles using your cycling path ✓	Prevention of hawkers/street vendors standing in your cycling path?	3
13	Prevention from other vehicles using your cycling path ✓	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	9
14	Prevention from other vehicles using your cycling path ✓	Preventing pedestrians walking on your cycling path?	5
15	Prevention from other vehicles using your cycling path ✓	Reduced waiting time at red light	5

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CyLOS, Cycling Level of Service Tool, 2014

What features in a proposed cycling facility do you prefer for cycling to/from school?			
Tick mark the preference between features (each row) and add a preference score for the selected			
	SELECT ROAD TYPE	ARTERIAL / COLLECTOR / ACCESS / STANDALONE	SCORE
16	Prevention from other vehicles using your cycling path	Cycle path which is clean,well-maintained, free from	7
17	Prevention from other vehicles using your cycling path	Smooth turnings which does not reduce your speed	3
18	Removal of obstruction like poles, broken surface, etc from cycling path	Adequate width of your cycling path	5
19	Removal of obstruction like poles, broken surface, etc from cycling path	Prevention of hawkers/street vendors standing in your cycling path?	7
20	Removal of obstruction like poles, broken surface, etc from cycling path	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	3
21	Removal of obstruction like poles, broken surface, etc from cycling path	Preventing pedestrians walking on your cycling path?	5
22	Removal of obstruction like poles, broken surface, etc from cycling path	Reduced waiting time at red light	5
23	Removal of obstruction like poles, broken surface, etc from cycling path	Cycle path which is clean,well-maintained, free from	7
24	Removal of obstruction like poles, broken surface, etc from cycling path	Smooth turnings which does not reduce your speed	3
25	Adequate clear width of your cycling path	Prevention of hawkers/street vendors standing in your cycling path?	5
26	Adequate clear width of your cycling path	Reducing number of vehicle crossings to enter property entrances, petrol pump, etc	7
27	Adequate clear width of your cycling path	Preventing pedestrians walking on your cycling path?	3
28	Adequate clear width of your cycling path	Less waiting time at red light	3
29	Adequate clear width of your cycling path	Cycle path which is clean,well-maintained, free from	5
30	Adequate clear width of your cycling path	Smooth turnings which does not reduce your	5
31	Prevention of hawkers/street vendors standing in your cycling path?	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	9
32	Prevention of hawkers/street vendors standing in your cycling path?	Preventing pedestrians walking on your cycling path?	5
33	Prevention of hawkers/street vendors standing in your cycling path?	Reduced waiting time at red light	5
34	Prevention of hawkers/street vendors standing in your cycling path?	Cycle path which is clean,well-maintained, free from garbage, etc	7
35	Prevention of hawkers/street vendors standing in your cycling path?	Smooth turnings which does not reduce your speed	3
36	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	Preventing pedestrians walking on your cycling path?	5
37	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	Reduced waiting time at red light	7
38	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	Cycle path which is clean,well-maintained, free from garbage, etc	3
39	Reducing number of vehicle crossings cycle path to enter road, gate, petrol pump, etc	Smooth turnings which does not reduce your speed	5

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CyLOS, Cycling Level of Service Tool, 2014

What features in a proposed cycling facility do you prefer for cycling to/from school?			
Tick mark the preference between features (each row) and add a preference score for the selected			
	SELECT ROAD TYPE	ARTERIAL / COLLECTOR / ACCESS / STANDALONE	SCORE
40	Preventing pedestrians walking on your cycling path?	Less waiting time at red light	7
41	Preventing pedestrians walking on your cycling path	Cycle path which is clean,well-maintained, free from garbage, etc	3
42	Preventing pedestrians walking on your cycling path?	Smooth turnings which does not reduce your speed	5
43	Less waiting time at red light	Cycle path which is clean,well-maintained, free from garbage, etc	7
44	Less waiting time at red light	Smooth turnings which does not reduce your speed	3
45	Cycle path which is clean,well-maintained, free from garbage, etc	Smooth turnings which does not reduce your speed	5

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CyLOS, Cycling Level of Service Tool, 2014

PREFERENCE SCORE	
Equally Preferred	1
Moderately Preferred	3
Strongly Preferred	5
Very Strongly Preferred	7
Extremely Preferred	9

EXAMPLE		
WHAT DO YOU PREFER? (CHOOSE ONE and TICK MARK IN THE BOX GIVEN)		SCORE - BY HOW MUCH do you prefer apple over orange?
APPLE	ORANGE ✓	7

What features in a proposed cycling facility do you prefer for cycling to/from school?			
Tick mark the preference between features (each row) and add a preference score for the selected option			
	SELECT ROAD TYPE	ARTERIAL / COLLECTOR / ACCESS / STANDALONE	SCORE
	ATTRACTIVENESS		
1	Safe Cycle parking available close to your destination ✓	Pleasing, nice and attractive environment including plants, benches, nice lighting, etc	5
2	Safe Cycle parking available close to your Destination	Cycle path which is clean,well-maintained, free from garbage, etc ✓	7
3	Safe Cycle parking available close to your destination ✓	Presence of activities such as shops and hawkers/vendors along the cycling path	3
4	Pleasing, nice and attractive environment including plants, benches, nice lighting, etc	Cycle path which is clean,well-maintained, free from garbage, etc ✓	7
5	Pleasing, nice and attractive environment including plants, benches, nice lighting, etc	Presence of activities such as shops and hawkers/vendors along the cycling path ✓	3
6	Cycle path which is clean,well-maintained, free from garbage, etc ✓	Presence of activities such as shops and hawkers/vendors along the cycling path	5

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10.6 Annexure 6 – Survey Form For School Children – Hindi Version

The same form was being translated in Hindi version for better understanding. The sample of Hindi version survey form is as follows:

CyLOS, *साइकिलिंग की सेवा का स्तर माप उपकरण*, 2014

CyLOS सॉफ्टवेयर उपकरण का एक प्रकार है जो योजनाकारों और डिजाइनरों को सुरक्षित और सुविधाजनक साइकिल पथ और सुविधाओं की योजना विकसित करने में मदद करता है. इस तरह साइकिल चालन के बुनियादी ढांचे, शहर भीतर यात्रा जैसे की स्थानीय दुकानों के लिए यात्राएं, स्कूल के लिए यात्राएं, काम के स्थानों तक की यात्राएं, के लिए सुरक्षित और उपयोगी होंगे. निम्नलिखित प्रश्नावली उपकरण के प्रदर्शन को बढ़ाने में सहायता करेगा. आप से अनुरोध है की कृपया इस पेज पर बुनियादी विवरण भरें फिर एक सड़क प्रकार का चयन करें जो तुम्हारे स्कूल तक पहुंचने की सड़क जैसा दिखता है. बाद के रूपों में, हर अंक पर दी दो सुविधाओं के बीच आप के लिए, आपके सड़क पर, अधिक महत्वपूर्ण, एक पर टिक करना, और यह आपके लिए कितना महत्वपूर्ण, है महत्व स्कोर से दर्शाना. दूसरे के ऊपर एक सुविधा की अपनी पसंद स्तर रेट करने के लिए, महत्व स्कोर इनपुट करना (1-9), जहां 1 का मतलब है कि दोनों सुविधाओं उतना ही पसंद कर रहे हैं, और 9 का मतलब है कि चयनित सुविधा बहुत अधिक पसंद किया जाता है.

नाम	अमित शर्मा			**उम्र**	16	**लिंग (नर/ महिला)**			नर
कक्षा	10							**अनुभाग**	क
स्कूल का नाम	सार्थक वरिष्ठ माध्यमिक विद्यालय							**शहर का नाम**	लखनऊ
कैसे आप स्कूल के लिए आए हो? (एक पर टिक (√) करना)									
पैदल	**साइकिल**	**ऑटो रिक्शा** ✓	**साइकिल रिक्शा**	**बस**	**वैन**	**कार**	**स्कूटर / मोटर साइकिल**	**अन्य (बताएं)**	
किस प्रकार की सड़क आपके घर से स्कूल को जोड़? (एक पर टिक (√) करना)									
1. उच्च गति मोटर वाहनों के साथ प्रमुख सड़क,									
2. कुछ कारों और दुपहिया वाहनों के साथ मुख्य सड़क, बहुत व्यापक नहीं									✓
3. दोनों पक्षों ने कम कारें, अधिक लोगों को दुकानों या घरों के साथ संकरी सड़क									
4. कोई सड़क - रास्ते या पार्क या अन्य खुले क्षेत्रों के माध्यम से जाती सड़क									

10.7 Annexure 7 – Survey Audit Form.

The form below should be used by the surveyor to collect data from site and fill the forms. The data collection form for Corridor/Route and Transit access influence area is same.

DATA COLLECTION FORM

Name of road: _____ Date: _____

Name of surveyor: _____ Time: _____

Total number of segments: _____

Segment Number: _____

Instructions to fill the forms:

1. There are six sections in the entire form which includes:
   a) Common form for the entire segment
   b) Observation sheet (Day time) – LHS
   c) Observation sheet (Day time) – RHS
   d) Observation sheet (Night time) – LHS & RHS
   e) Description sheet (Day and Night time)

2. * - This symbol indicates to refer description sheet. The category to be filled is explained in the description sheet for the respective item.
3. For proper information data should be collected in peak hour time. Also complete form should be filled in one time slot.
4. Each segment should be divided in a range of 200 m up to 800 m. If the segment is more than 800m long a separate form can be used.

a. Common Survey for Entire Segment

S.No.		
1	**Type of Road (Tick any one)**	
	Highway	
	Arterial/ Sub Arterial (30 - 80 m)	
	Collector/Distributor (12-30 m)	

	Local - (6 -15 m)	
	Independent track/facility -(upto 6m)	
2	**Carriageway traffic along segment (Tick any one)**	
	LHS & RHS (2 way)	
	One Way (LHS)	
	One Way (RHS)	
	Independent path	
3	**Right of way (ROW)**	
4	**No. of lane**	
5	**Segment Length (km)**	
6	**Posted speed limit**	
7	**Peak hour Traffic data**	
	No. of motor vehicles (PCU)	
	No. of Bicycle	
	No. of auto rickshaw	
	No. of goods rickshaw	
	No. of Pedestrians	
8	**Bicycle user share**	
	Passenger only (no.)	
	Passenger with goods (no.)	
9	**Type of Cycle track/lane (Tick any one)**	
	Segregated track	
	Painted track	
	Unsegregated (common with carriageway)	
	Common with footpath	
10	**Location of cycle track/lane (Tick any one)**	
	Along carriage way	
	Along footpath	
	Along property edge	
	On the median	
	Between on street parking & carriageway	
	Between service lane & property edge	
	Independent Standalone	
11	**Surface Type (Tick any one)**	
	Asphalt	
	Concrete	
	Smooth tiled	
	Paver blocks	
	Concrete slabs	
	Others	
12	**Cycle parking cost (rupees per day)**	

13	**Primary Intersection type (Tick any one)**	
	Signalized junction	
	Unsignalized junction	
	One lane roundabout	
	Two lane roundabout	
	Rotary	
	Grade separated	
	Not applicable	
	If Intersection type is not applicable then 11 - 23 are not to be filled.	
14	No. of major junctions	
15	Observed wait time at the junction	
16	Traffic calming at intersections (Yes/No)	
17	Demarcated cycle stacking spaces at intersection (Yes/No)	
18	**Primary cyclist crossing type across intersecting roads (Tick any one)**	
	Crossing with or without marking	
	Raised crossing	
	Grade separated (underpass or overpass)	
	Signalized with or without raised crossing	
	No provision for crossing/ physically prevented from crossing	
19	**Primary cyclist crossing type across free left turns or segregated left turn lanes (Tick any one)**	
	Crossing marked across carriageway	
	Raised crossing	
	Grade separated (underpass or overpass)	
	Segregated left turning lanes exists	
20	**Primary cycle infrastructure along intersection boundary (Tick any one)**	
	Segregated from carriageway and footpath	
	Common with footpath but segregated from carriage way	
	Painted marking on the periphery along circular roadway	
	No Segregation/demarcation - common with carriage way	
21	**Width of cycle track/lane at the junction (m)**	
22	**Cyclist approach to the Intersection (Tick any one)**	
	Segregated track	
	Cycle lane (painted)	
	Unsegregated	
	Common cycle track and footpath	
	As part of or along service lane	
	Stand alone	
23	**Additional grade separated cycle crossings in the segment**	
	Foot over bridges (no.)	
	Subways (no.)	
24	**Primary speed/conflict control measure used at mid block cyclist or pedestrian crossing (Tick one)**	

	Traffic calmed	
	Pedestrian signal with or without traffic signal	

b. Observation Sheet (Day) - LHS

S.No.	Chainage		0-200 m	201-400 m	401-600 m	601-800 m	Average/Min.
1	Shaded length % on Cycle track/lane						Average
2	% length of divided carriageway in the segment						Average
3	Observed peak speed						Average
4	Land use*						Average
5	Length with service lane						Total
6	Quality of service lane(Good, Bad, poor)*						Average
7	Length of Footpath						Total
8	Quality of footpath (Good, Bad, Poor)*						Average
9	No. of hawkers present						Total
10	No. of parked IPT						Total
11	No. of parked private vehicles on carriageway						Total
12	Height of cycle track/lane w.r.t. to carriageway						Average
13	Minimum width of cycle track/lane						Min.
14	Segregation width between cycle track/lane/path & carriageway						Average
15	Edge height	Left Side					Average
		Right Side					Average
16	Minimum Turning Radius						Min.
17	No. of obstructions						Total
18	Slope of Ramp*						Average
19	Presence of cycle specific signage & marking						Total
20	Location of bus stop*						
21	No. of property entrances						Total
22	No. of secondary lane entrances / minor junctions						Total
23	No. of signalised or traffic calm pedestrian/cycling crossings at carriageway						Total
24	Level of cycle track/lane crossing at minor junction/collector road entrance*						Average
25	Level of cycle track/lane crossing at property entrance*						Average
26	No. of cycle/NMV parking						Total
27	Quality & maintenance of Cycle track/ lane						Average

28	Quality of landscaping & environment					Average
29	Encroachment on cycle track/lane by private vehicles*(refer description sheet)					Average
30	Approx. % of total cyclist using bicycle infrastructure					Average
31	Approx. % of total NMV parking using designated parking NMV bays					Average

c. Observation Sheet (Day) - RHS

S.No.	Chainage		0-200 m	201-400 m	401-600 m	601-800 m	Average/Min.
1	Shaded length % on Cycle track/lane						Average
2	% length of divided carriageway in the segment						Average
3	Observed peak speed						Average
4	Land use*						Average
5	Length with service lane						Total
6	Quality of service lane(Good, Bad, poor)*						Average
7	Length of Footpath						Total
8	Quality of footpath (Good, Bad, Poor)*						Average
9	No. of hawkers present						Total
10	No. of parked IPT						Total
11	No. of parked private vehicles on carriageway						Total
12	Height of cycle track/lane w.r.t to carriageway						Average
13	Minimum width of cycle track/lane						Min.
14	Segregation width between cycle track/lane/path & carriageway						Average
15	Edge height	Left Side					Average
		Right Side					Average
16	Minimum Turning Radius						Min.
17	No. of obstructions						Total
18	Slope of Ramp*						Average
19	Presence of cycle specific signage & marking						Total
20	Location of bus stop*						
21	No. of property entrances						Total
22	No. of secondary lane entrances / minor junctions						Total
23	No. of signalised or traffic calm pedestrian/cycling crossings at carriageway						Total
24	Level of cycle track/lane crossing at minor junction/collector road entrance*						Average

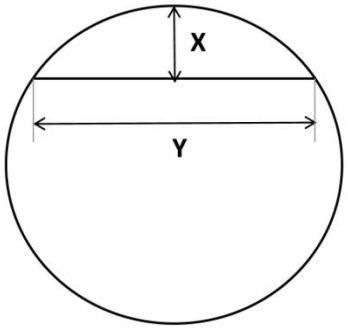
25	Level of cycle track/lane crossing at property entrance*					Average
26	No. of cycle/NMV parking					Total
27	Quality & maintenance of Cycle track/ lane					Average
28	Quality of landscaping & environment					Average
29	Encroachment on cycle track/lane by private vehicles*(refer description sheet)					Average
30	Approx. % of total cyclist using bicycle infrastructure					Average
31	Approx. % of total NMV parking using designated parking NMV bays					Average

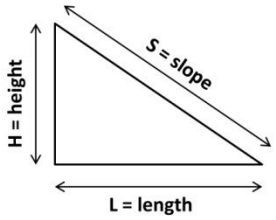
d. Observation Sheet (Night) - LHS and RHS

OBSERVATION SHEET (NIGHT) -LHS						
S.No.	**Chainage**	**0-200 m**	**201-400 m**	**401-600 m**	**601-800 m**	**Average/Min.**
1	Lighting on cycle track - lux level (40 lux, 20 lux, >10 lux)*					
2	Lighting uniformity on cycle track/lane/path (Good, Bad, Poor)*					
3	No of hawkers					

OBSERVATION SHEET (NIGHT) -RHS						
S.No.	**Chainage**	**0-200 m**	**201-400 m**	**401-600 m**	**601-800 m**	**Average/Min.**
1	Lighting on cycle track - lux level (40 lux, 20 lux, >10 lux)*					
2	Lighting uniformity on cycle track/lane/path (Good, Bad, Poor)*					
3	No of hawkers					

e. Description Sheet (Day and Night) – LHS & RHS

DESCRIPTION SHEET (DAY)		
S.NO.	**SURVEY FORM - LHS & RHS**	
4	**Land Use**	
A	Commercial /Retail	
B	Residential	
C	Others - Institutional, Recreational, Green, etc.	
D	Commercial + Residential	
E	Residential + Others	
F	Commercial + Others	
6	**Quality of service lane**	
	Good (Grade A)	Width >= 6m, Lighting level=18 lux, Uniformity =40 %, No Obstructions, Footpath - 1.8m, segregated
	Bad (Grade B)	Width 4.5m to 6m, Lighting level=15 lux, Uniformity =33 %, No Obstructions, Footpath - 1.2 to 1.8m, segregated
	Poor (Grade C)	Width >=4.5m, Lighting level>15 lux, Uniformity =33 %, Obstructions present, Footpath - 1.2, unsegregated
8	**Quality of footpath**	
	Good (Grade A)	Width 1.8m, Height-18 cm, No Obstruction, Excellent surface quality, Proper cross slope, barrier free
	Bad (Grade B)	Width 1.8 to 1.5m , Height-20 cm, Obstructions present but clear width 1.2m achieved, Excellent surface quality, Proper cross slope, barrier free, Pavement may not include tactile
	Poor (Grade C)	Width = 1.5m , Height-20 cm, Obstructions present but clear width 1.2m achieved, Poor surface quality, Improper cross slope, Not disabled friendly, Poor surface quality of pavement.
16	**Calculate turning radius** **$R = Y/2 + X^2/8 \times Y$**	

18	**Calculate slope** $S^2 = H^2 + L^2$	
19	**Location of Bus stop**	
A	No bus shelter on kerbside	
B	Cycle track between bus shelter & carriageway	
C	Bus stop between cycle track and carriageway	
D	Bus stop on cycle track	
24	**Level of cycle track/lane crossing at minor junction/collector road entrance**	
A	At carriageway level	
B	Level of cycle track remains same (above carriageway)	
C	At footpath level	
25	**Level of cycle track/lane crossing at property entrance**	
A	At carriageway level	
B	Level of cycle track remains same (above carriageway)	
C	At footpath level	
29	**Encroachment on cycle track/lane by private vehicles*(refer description sheet)**	
	Well enforced	No encroachment by motorist & no parking
	Partly enforced	Encroachment by motorist near intersections & no parking
	Lack enforcement	Motor vehicles routinely encroach & park on cycle track

DESCRIPTION SHEET (NIGHT)		
S.NO.	**SURVEY FORM - AT NIGHT**	
1	**Lighting on cycle track - lux level**	
	40 lux	Distinguishable till 200 m
	20 lux	Distinguishable till 100 m
	> 10 lux	Distinguishable till 50 m
2	**Lighting uniformity level**	
	Good	No dark patches throughout the track/lane
	Bad	Clearly visible dark areas between light poles
	Poor	No lighting at all in the entire track/lane

References

2009, *Work zone Safety Manual*, Transportation Reserch and Injury Prevention Programme.

2013a, *Non Motorized Transport Planning and Guideline*, Transportation Reserch and Injury Prevention Programme.

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2013c, *Urban Road Safety Audit Toolkit*, Transportation Reserch and Injury Prvention Programme.

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