Health information systems in developing countries have historically been criticised for not contributing to information use for supporting action at local levels at the point of service delivery. While data which is collected is primarily used to be sent upwards to the central ministry where it is used for the compilation of statistics, it is not used for supporting everyday action towards local interventions. Examples of such local action could be of the field nurse using the health information to identify which children are dropping out from their immunisation cycle or to identify pregnant women in a village that need to be motivated to accept institutional (rather than home) delivery. Medical officers in a health facility can use the information to see how their reporting sub-units are performing to help plan for more optimal resource allocation. Local action can be of various types including for monitoring, planning and evaluation around the different health services that are being delivered.

While the above examples seem obvious uses of information, and even may appear relatively easy to achieve technically, in practice it has been found quite problematic to materialise. Contributing to this are various knowledge demands and socio-technical challenges. Knowledge challenges relates to the fact that hands-on tacit practical knowledge relevant here needs to be developed through routine processes of learning-by-doing, where the problem is that such routine processes of using information for action are not taking place, leaving us with a chicken-egg problem of “How to start creating such learning processes?”. Technical challenges include the use of rigid, centralised, proprietary systems, that are not oriented towards supporting local use, are inflexible to change, and do not promote interoperability across systems. Often, health departments go in for the purchase of complex and expensive statistical packages which are not amenable to key public health analysis of generating indicator graphs, drilling down and making comparisons across facilities and over time. Public health related challenges include the focus on raw data rather than processed indicators, and the violation of the hierarchy principle where all raw data collected in the field is sent to the central ministry. Lack of standardised definitions of data elements and indicators, redundancies in data collection forms, coupled with high existing work load of field staff serves as serious deterrents to the use of information for local action. Computerisation efforts, in such contexts, typically take on the agenda of automation with a high focus on the technicalities of hardware and software, while implementation support to promote local action tends to get marginalised.

While we tend to understand the reasons behind the poor use of information, we have more limited understanding of how to address this challenge. Superficial recommendations of “more training is needed” remains rather ineffective as it does
Local action, by definition is situated, contextualised and represents knowledge in-use that should necessarily provide practical benefits to the user. An operational definition of local action is the use of health information for understanding and supporting work practices of the health functionaries (such as field nurses, medical doctors, district administrators) for the design, implementation and monitoring of interventions towards practically improving health outcomes. While such action is largely based on the everyday experiences and local knowledge that health staff have, this can undoubtedly be strengthened by appropriately designed HIS which enable the processing, analysis and display of data, and its utilisation by users to guide practical action and gain practical benefits. For example, if by using the computer based HIS, the field nurse can reduce her burden of manual compilation of report or minimise her time of travel to deliver reports, or be able to identify more correctly those pregnant mothers who have skipped a check up, she obtains practical benefits and further motivation to use the HIS.

Challenges to achieving these practical benefits are socio-technical in nature, including related to technology, the domain of public health, the context of implementation. Building capacity of users to use information for local action needs to address these three inter-related domains. This is now discussed.

10.1.1 Technology related capacity

This relates to the capacity of health staff to use technology (the HIS application) to take practically useful local action. Such capacity is conceptualised as the practical capacity to use the HIS and to solve basic technical issues to keep the application operational. This definition helps to identify the following facets of technology related capacity:

- **Capacity to carry-out local customisation**: This reflects the ability of the user to make local changes and customisations in the HIS to address local needs, such as:
  - Addition or deletion of local data elements in the database;
  - Modifying organisational unit structure to reflect changes in the hierarchy;
  - Creating new validation rules for carrying out data quality analysis; and,
  - Creating new indicators for conducting health status analysis.

Building capacity to carry-out these concrete operations, not only helps users in their everyday work, but also empowers them by reducing their dependencies on external agencies for support. Increased self-reliance provides users with more freedom to learn other things. Below, we provide examples of making modifications in the organisation units (Figure 10.1) and data elements (Figure 10.2) in the DHIS2, directly through the user interface without any programming intervention. The skills to carry-out such local
customisation can be developed relatively easily through focused training, and helps to demystify the technology for the user.

*Capacity to use the data analysis tools:* This capacity helps provides the user with the ability to use data analysis tools such as Pivot Tables and Dashboards for visualising and presenting data and indicators. Representations such as charts, graphs and maps
helps the user to visualise data pictorially, and understand better how ‘data behaves’ to enable the taking of relevant local action. Some examples of the practical tasks the user can carry-out through these data analysis tools include:

- Creation of “achievement against target” charts.
- Creating routine performance charts.
- Comparison of related indicators.
- Comparison of indicators across health facilities.

As an example, a chart is shown below.

In Figure 10.3 the yellow line represents the cumulative monthly target given to the health worker for a particular service she is expected to provide (in this example administering BCG doses), while the brown and blue bars represents the monthly and cumulative achievement figures. Health workers by viewing the above chart can assess their monthly progress in relation to their targets and take required corrective action. This supports self-monitoring, intrinsically more empowering than when externally controlled.

Another example is given in Figure 10.4 on skilled birth assisted deliveries.

The above graph on district wise performance of skill birth assisted deliveries can be useful for the state level planner to assess district performance on an important parameter, also relevant for MDG goal achievement. By identifying poor performing districts, the planner can in consultation with the district, seek to design relevant interventions such as increasing skill birth assistance training, providing more facilities for basic emergency obstetric care services, and improving referral transport services for pregnant mothers.

Figure 10.5 of the dashboard in the DHIS2, shows how the user can select their required indicators and compare them across all facilities under a parent organisation.
Figure 10.4 Percentage of skilled birth attendants assisted deliveries across districts

Figure 10.5 Use of dashboard monitoring tools of DHIS2
(districts in a state, or blocks in a district) and also over time. This provides the user with the flexibility to carry-out local data analysis and monitoring of performance across their own health facilities, to make effective diagnosis, and based on this, focused action.

**Capacity to carry-out basic troubleshooting of technical problems:** This capacity concerns the ability of users to address basic technical problems in the HIS before seeking external technical help. This is relevant for firstly providing the user with a sense of local control and understanding of the application, and secondly to reduce external dependencies, often hard to obtain in rural settings. Some examples of such skills include:

- Ability to reset forgotten passwords for users in the application;
- Skills to create new users and define their access roles.
- Ability to address data mismatches between data entry and reports: A common problem in data aggregation is the mismatch between data entered and the report generated. Often, this is attributed as a software bug, while it could be a data entry mistake, where data for same data elements are entered both at the child and parent organisational unit levels, creating a duplication in aggregation, hence the data mismatch.

![Figure 10.6](image) Functionality to create new user and reset of password

Figure 10.6 represents the user interface for creating new users and the resetting of forgotten passwords. Users with due access to carry-out this operation can create new users and also help users with lost passwords, a very common occurrence in the field.

**Capacity to use visualisation tools such as GIS:** This capacity concerns the skills required towards the use of GIS for improved visualisation of data, including the generation of health indicators and viewing them on a map. This does not involve core technical skills on GIS such as the creation or editing of a map, a function more appropriate for the state level. Map based visualisation of indicators provides a powerful avenue for users to spatially understand issues, for example, the prevalence of a disease across a district, and which surrounding facilities it can affect. Seeing these spatial inter-connections can help to identify necessary actions. Some specific skills that can be developed for the user in this regard include:
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The Figure 10.7 represents a snapshot from the GIS module in DHIS2, and the functionality to export it to a presentation. This allows the user to link health data, both indicators and data elements, to a spatial map.

10.1.2 Public health related capacity

Public health capacity can be operationalised as the ability of health professionals to interpret and use information for supporting their everyday work. Such knowledge relates to the understanding of diseases, their determinants, and also about the different services (e.g. immunisation) that the health system provides. The relation between these domain issues and the HIS is primarily through the ability to define appropriate data elements that need to be collected (which should reflect the problem to be addressed), how these data elements can be converted into actionable indicators, and their interpretation and action in the context of the problem on hand. Some specific skills in this regard include:

- Ability to differentiate between a GIS (e.g. shape file) and non-GIS map (e.g. jpeg file);
- Ability to use the GPS to record the longitude and latitude for health facilities;
- Capacity to use the GIS software to help generate health maps to display health indicators and data elements; and,
- Skills to export the generated maps to jpg so format that they can be included in presentations and documentations.

The Figure 10.7 represents a snapshot from the GIS module in DHIS2, and the functionality to export it to a presentation. This allows the user to link health data, both indicators and data elements, to a spatial map.

Figure 10.7 Screen shot of user interface of GIS module in DHIS2

10.1.2 Public health related capacity

Public health capacity can be operationalised as the ability of health professionals to interpret and use information for supporting their everyday work. Such knowledge relates to the understanding of diseases, their determinants, and also about the different services (e.g. immunisation) that the health system provides. The relation between these domain issues and the HIS is primarily through the ability to define appropriate data elements that need to be collected (which should reflect the problem to be addressed), how these data elements can be converted into actionable indicators, and their interpretation and action in the context of the problem on hand. Some specific skills in this regard include:

- Capacity to understand data elements and indicators, and their significance in use: This capacity concerns the ability of health staff to have a common understanding of data definitions and linkages towards actionable indicators. For example:
  - How to use the data dictionary which provides data definitions, guidelines and processes of aggregation; and,
How to use the indicator dictionary which provides indicator definitions, their rationale for use, suggested actions and levels of use.

The excerpt from a data dictionary provides the definition of the data element *Total number of pregnant women registered for ANC*, guidelines for its collection and details of the primary source of data – the antenatal or pregnancy register (Box 10.1).

Box 10.2 represents the screen shot from the indicator dictionary for antenatal care first visit coverage rate, giving the definition, the data elements to be included in the numerator and denominator, and the rationale for use.

---

**Box 10.1**  
An example of the data element dictionary

| Data Element: Total number of pregnant women registered for ANC  |
| --- |  |
| **Definition:** Total number of NEW pregnant women registered for antenatal care during the reporting month.  |
| **Guideline:** The visit should include relevant check-ups required for antenatal care. Registration should include ANC check-up. ANC first check-up is same as ANC registration. A pregnant woman is generally registered during the very first contact with the health facility/worker, irrespective of her state of pregnancy.  |
| **Data Source – Antenatal Register/Pregnancy Register**  |

**Box 10.2**  
Indicator dictionary for Antenatal care first visit coverage rate

| Indicator: MH 1: Antenatal care first visit coverage rate  |
| --- |  |
| **A:** ANC under 19 years  |
| **B:** ANC in first trimester  |
| **Definition:** Percentage of pregnant women who used Antenatal Care (ANC) provided by skilled health personnel, for reasons related to pregnancy, registered and examined for the first time and received some form of care, such as TT1  |
| Women under 19 years of age  |
| First visit in first trimester of pregnancy  |
| **Numerator:** ANC first (initial or registration) visit  |
| ANC first visit under 19 years  |
| ANC first visit in first trimester of pregnancy  |
| **Denominator:** Total expected pregnancies  |
| A and B ANC first visit  |
| **Rationale:** This first visit should be a *registration* visit where all initial procedures relating to assessing/preparing a woman for pregnancy and delivery occur. This should include full history examination initial blood tests and immunisation. Antenatal care coverage is an indicator of access and use of health care during pregnancy. All women should have at least three antenatal visits during a pregnancy. These should start as early in pregnancy as possible.  |
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**Data Source**
ANC under 19 years shows proportion of teenage pregnancies and ANC booking in first trimester shows early care and level of awareness.

Population data – an estimate of the number of pregnant women is close to the number of children born (2.2 – 3.2% of population).


**Suggested level of use**
National and below.

**Other Useful Indicators**
Risk and continuity indicators are important in ANC.

VDRL (syphilis) and HIV testing coverage shows quality for care. This should be taken at first ANC visit.

Haemoglobin testing and anaemia management rates

ANC referral shows risk detection (and transport availability)

% women getting third ANC shows continuity of care, which is often related to perceived quality.

Unbooked deliveries at facilities is an accurate indicator of failure of ANC services.

**Common Problems**
Attendance for pregnancy test or simple registration without history and examination do NOT constitute antenatal care.

numerator and denominator, and the rationale for its use. It also identifies other related useful indicators and common problems toward its articulation. This information assists the health planner to use of this indicator in local analysis and planning, and primarily for taking action.

**Capacity around understanding data element behaviour:** This capacity concerns the ability of health staff to understand the behaviour of data elements in relation to other related elements. This helps diagnosis of action points to improve data quality. Some specific skills in this regard include:

Identifying related data elements and their behaviour.

Identifying acceptable ranges of data elements, including “min” and “max” values to monitor data quality.

The line chart (Figure 10.8) represents a comparison between two related indicators, institutional (shown by blue line) and home delivery rates (depicted by red line), across districts of a state in a particular year. This helps to identify districts with low institutional delivery rates and design corrective measures to strengthen delivery services.

Figure 10.9 shows the data entry screen in DHIS2 depicting values of particular data elements for the past 13 months with respect to min and max ranges. This helps the person doing the data entry to view at the point of entry, whether the value lies in an acceptable range, which shows as red if out of range. Additionally, the user has the possibility to fill in an comment as a reason for out of range data, such as stating that the vaccine was out of stock or if a staff was on leave. This helps to distinguish between an abnormal value as a “data artefact” (such as a typing error) or representing a “health programme artefact.” Such a distinction is necessary given that the normal
Figure 10.8 Comparison of institutional and home delivery rates across districts

Line Chart
Service: Institutional delivery rate, Home delivery rate, Organisation Unit: Gujarat State
Period: 2008-04-01 to 2009-03-31

Facilities
- Home delivery rate
- Institutional delivery rate
- Home delivery rate (Target)
- Institutional delivery rate (Target)
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Tendency is to attribute all data related issues as data problems (due to manipulation or wrong entry), which draws attention away from health programme related problems which may require different kinds of interventions such as improving the cold chain supply of vaccines. This additional comment not only validates the data but also helps to provide useful local context to the raw data.

Capacity to develop interpretations of data to help design local action: This concerns the ability of health staff to develop a public health based interpretation of data to help design local action. For example: Figure 10.10 represents a chart depicting figures against related events of ANC cases, births, BCG and Measles. Further, the chart compares registered figures for a period in one district, and compares it with

![Data Entry Screenshot](image)

**Figure 10.9** Screen shot of data entry screen with min and max range for data elements

![Data Chart](image)

**Figure 10.10** Data from one district plotted against the estimated target populations.
estimated figures for the same events. By looking at the two lines in conjunction, the staff can interpret that the registered figures are less than about 20% of the estimates, but however this gap is relatively reduced in the case of BCG and Measles. This graph helps the health staff to identify the specific points where she needs to strengthen action to improve her achievements with respect to what she is expected to do based on population estimates.

Understanding target population and basic demography: This capacity concerns how the health staff understands the target population she is dealing with, a concept fundamental for the analysis of indicators and of achievements (service given) against targets (what was supposed to be achieved). Some examples of target populations that are relevant for indicator analysis include:

Children under 1 year is a key denominator and is used for calculating immunisation coverage. For vaccines given right after birth, e.g. Polio 0 and BCG, the number of live births is used, for vaccines given after 9–12 months, such as measles, the number will be live births less the estimated infant mortality rate.

The number of live births per 1,000 population is a key demographic rate, also called Crude Birth Rate (CBR), used for estimating children under one, pregnant woman and population growth. Live births per 1,000 population varies strongly between countries, from less than 20 in Kerala to 35 in Uttar Pradesh, and from 23 in South Africa to more than 40 in most sub-Saharan Africa.

Number of pregnancies is an important denominator used for, e.g. calculating ANC coverage with number of First ANC visits as numerator. Pregnancies may be estimated as the number of live births plus the number of still births, miscarriages and abortions, which, for example, is estimated by UNFPA as being 15% in sub-Saharan Africa. Using this estimate, the estimated number of pregnant women in an area will be the number of live births + 15%.

<table>
<thead>
<tr>
<th>Crude Birth Rate</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live births as % of population</td>
<td>1,5%</td>
<td>2%</td>
<td>2,5%</td>
<td>3%</td>
<td>3,5%</td>
<td>4%</td>
<td>4,5%</td>
</tr>
<tr>
<td>Estimated pregnancies As % of population</td>
<td>1,7%</td>
<td>2,3%</td>
<td>2,9%</td>
<td>3,45%</td>
<td>4%</td>
<td>4,6%</td>
<td>5,2%</td>
</tr>
</tbody>
</table>

Estimated numbers of pregnancies and live births are useful in assessing the quality of the data on registered births, and in calculating institutional delivery rates. Comparing institutional deliveries against reported and estimated pregnancies helps also to understand what percentage of the target population have been provided basic services.

Children under 5 years is used for calculating proportion OPD and hospital services given to children, and it will be between 4 and 5 times the Crude Birth Rate (5 X under one less child mortality rate). While in sub-Saharan Africa the percentage of the population under 5 years will be around 17 – 18%, in India the average is 10.5%.

Women in child bearing age is defined as women between 15 and 49, and is the target for family planning services and is used as denominator for calculating coverage of these services. In India “eligible couples” are used as denominator, which are defined as a currently married couple, the wife being in the reproductive age group. It is
estimated that there are 150 to 180 eligible couples per 1,000 population in India. The percentage of women between 15 and 49 in a population differ between countries depending on their demographic profile.

Capacity to define locally relevant indicators: While the technology can allow a user to define indicators relevant for them, public health knowledge is required to understand what these required indicators are. This understanding comes with an intimate sense of the local situation, including the ongoing problems that need to be addressed. For example: antenatal care, skill birth attendance and institutional deliveries arguably are key indicators to manage the problem of maternal mortality. For this, the following indicators are relevant:

ANC coverage rate which is defined as the percentage of pregnant women that were provided antenatal care service by the health worker at least once during pregnancy. And, ANC TT2 or TT booster coverage rate indicators are defined as percentage of pregnant women who received TT2 or TT booster vaccine. While the ANC coverage rate indicators provide an indication of coverage of care, the others indicate the quality of care.

Similarly, institutional delivery rate, which is defined as a percentage of institutional deliveries with respect to total delivery, provides an indication of coverage, while that of discharge rate within 48 hours after institutional delivery indicates the quality of institutional delivery services.

Capacity to define local validation rules: This capacity relates to the conduct of data quality analysis based on locally articulated validation rules. For example: Monthly reports of health data contain various inter-related data elements which could be cross checked to help analyse quality. For example, pregnant women registered for ANC under first trimester represents a subset of the total pregnant women registered for ANC, implying the subset cannot be greater than the total. Similarly, total deliveries reported should be equal to the number of live births plus stillbirths (notwithstanding the possibility of twin births). The ability of the health staff to identify such relevant local validation rules and how these can be used to make improvements in data quality is an important aspect of local public health knowledge.

10.1.3 Implementation related capacity

Technical and public health related capacity is inter-linked in a situated implementation context. For example, using information to identify children dropped out from the immunisation programme, plays out within a particular implementation setting, and demands both technology related (how to use and support the HIS) and public health capacities (how to interpret a data element and immunisation coverage indicator) to be combined. The implementation setting is defined by various conditions such as how work practices are organised, institutional arrangements for verification of data and providing feedback and supervision, the available infrastructure of registers, computers, and internet. The introduction of new technology undoubtedly has the potential to reconfigure this work context, and also the context itself helps shapes the nature of what HIS solutions designed. For example, the use of the mobile phone to send data directly by SMS to the central server will necessarily affect existing practices of manual recording and transmitting of data. And, whether the mobile solution developed is based on SMS or GPRS technology is shaped by the ability of the context to support particular kinds of technical solutions. Some specific capacities related to understandings of the implementation context include:
Understanding how the HIS relates to work practices around information flows: This capacity concerns the ability of health staff to understand how different types of health data are collected by institutions based on the services they provide. For example:

- The District Hospital, representing a tertiary care facility, reports on Comprehensive Emergency Obstetric Care Services (CEmOC) such as C-sections and blood transfusions which are not available at lower level facilities. So, such data should only reflect in the Hospital and not PHC datasets.
- Similarly, home deliveries would be reported by the outreach centres, and not by other health institutions which do not provide specific outreach services.
- Further, data elements for programmes like IDSP (Integrated Disease Surveillance Programme) are collected at a different frequency (daily or weekly) as compared to the routine monthly HIS data. The flow to support this data needs to be thus different from HIS reports.

Procedures around data flows, data verification: This capacity concerns the ability of health staff to establish, follow and understand procedures around data flows, data verification and providing feedback to field staff on data issues. For example:

District monthly reports comprise of data from different health programmes such as mother and child care, immunisation, blindness control, district stocks and so on. The concerned programme managers need to verify their respective data and endorse it with their signature, and the overall in-charge of the district health system (the district medical officer) needs to verify the integrated report before transmitting it to the state level, where a similar process of authentication is done before it is sent to the national level. The HIS must thus be able to reflect these work practices, and if the system demands changes in the practices, then these must be well understood by the health staff.

The process of feedback is important, such as providing comparisons of selected indicators across all children units (all districts in a state for example), across its parent unit, and across time periods (months in a year). Feedback reports not only help improve quality of data, but builds in an accountability as the reports are compared to specific performance indicators. In the absence of feedback, staff may doubt the utility of a HIS as they see no local value. The picture shows a feedback meeting from the state of Kerala in India (Figure 10.11).
The Table 10.1 summarises this discussion to show different facets of capacity relevant to strengthen local action, along with practical examples.

<table>
<thead>
<tr>
<th>Characterised by</th>
<th>Technology related capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running example</td>
<td>Using the user interface to make correction in data elements, organisation units, its hierarchy, validation rules and indicator definitions.</td>
</tr>
<tr>
<td>Functional value of knowledge</td>
<td>User can work with a locally relevant system which he/she can guide towards supporting local health interventions. User builds capacity for carrying out local customisations towards dealing with the ongoing and changing needs of the health system.</td>
</tr>
<tr>
<td>Public health related capacity</td>
<td>Identification of areas of concern requiring action, such as high drop-out rates from immunisation and low performance on service delivery.</td>
</tr>
<tr>
<td>Functional value of knowledge</td>
<td>User built capacity towards interpretation of trends from graphs and charts, and being able to articulate this understanding towards designing local planning and action.</td>
</tr>
<tr>
<td>Implementation context related capacity</td>
<td>Work practices, culture towards data collection and understanding information flows.</td>
</tr>
<tr>
<td>Running example</td>
<td>Understanding services deliveries by different health facility types and how these relate to the HIS. Understanding the data collection and reporting frequencies of different health programmes. Defining the role of health supervisors at different levels of the health administrative hierarchy to provide relevant feedback Institutional procedures in place for data collection, verification and transmission.</td>
</tr>
<tr>
<td>Functional value of knowledge</td>
<td>Capacity of health managers and planners in designing relevant data collection forms and their flows. User built capacity towards scrutinising data quality and establishing constructive feedback processes.</td>
</tr>
</tbody>
</table>

### 10.2 Participatory Approaches to Building and Scaling Capacity

Building capacity is a multi-level task inherently involving the challenge of scale from individual to facilities to the health system. Two approaches towards this are presented. The first is of building collaborative networks, and this is illustrated through an example from Kerala, India. The second is through the approach of master trainers.
10.2.1 Building collaborative networks: Example from Kerala, India

Collaborative networks have been described by Braa et al (2004) as a key strategy towards building and scaling of capacity. The underlying principle is that people learn more effectively in a collective rather than a singular mode, because of the potential that it provides to share and learn from each other, and to also circulate material, ideas, people and resources through the network to enable sharing without having to reinvent the wheel. From the participatory design tradition we bring in the need for users and other stakeholders to actively participate in the design and building of the system, by adapting solutions and best practices from elsewhere and by inventing new ways of doing things. Success will depend on the creation of a sense of ownership to the system from the local users, which maybe fostered through collaborative processes and through being given a say in the design of the system. Another key component of the participatory design tradition is to acknowledge and address the fact that knowledge about the system needs to be developed in a mutual process between the developers, users and the context of work and system practices. Typically, the users will have both concrete and tacit knowledge about their own situation, work practices and wider context of work, all of which the developers will be more or less oblivious to. The developers on their hand, however, will have knowledge about technical solutions and on how these can be adapted and used, knowledge which the users are lacking. Given this situation, the participatory approach is for users and developers to cooperatively engage with systems development on the ground and together develop the “new” combined knowledge about how new work practices and systems solutions maybe developed in a mutually learning approach; everybody will learn and a sort of new knowledge will be developed. Both users and developers will engage with the context and, typically, in a step-by-step and evolutionary process develop the new system – and by definition new knowledge.

Bringing networking into participatory design is to acknowledge that there are multiple actors and users with various relationships to the system at the local as well as at “higher” levels, such as in the district and state, and in different areas; from clients of the health services, to the local political bodies, and various health programmes. Various elements contribute to create enabling or constraining conditions for such networking to build and scale capacity. In Kerala, where HISP India has been active since 2006, the approach taken was to consciously develop collaborative networks that could support capacity development. The network involved the various health units, public health institutions, other training institutions, HISP India and HISP Global, with linkages being promoted by design to support capacity development.

The context of the health system helps to shape processes of capacity development and their scaling. The context in Kerala was provided through institutional conditions such as the political history of the Left government, state policy of support to free software for the public sector, and a strong culture of decentralised governance. This context has made it conducive for the ideology of information for local and decentralised action based on free and open source software to thrive, and the state took ownership to scale training and capacity building processes state-wide.

Within this enabling environment, HISP India played an active and operational role in building capacity – also their own capacity and learning! – around HIS, with a focus on strengthening information use towards taking local action. HISP India, through their technical support agreement with the state, established district teams who
were directly involved in building capacities of local teams at the health facility levels. This engagement generated positive implications mutually, for the health staff to gain knowledge of the HIS, and for the HISP team to better understand the implementation context. Various mechanisms were used for building capacity. During the initial development of DHIS2, workshops were held at a local public health institution with medical doctors from the health facilities of Trivandrum district, where the first prototype of DHIS2 was presented. Such workshops helped the HISP team to understand the nature of public health inputs needed to be incorporated in system design. For example, the doctors expressed concerns of security – a nurse should only be able to see data from her facility and not of others. DHIS2 itself played a key role in scaling capacity through the network. One, by its “free” nature, it could without the license restrictions be taken to all the facilities in the state. Local requirements understood through various participatory means could be inscribed in the DHIS2 process of continuous development and new releases.

The deployment model for the DHIS2 over time changed from a centralised to an increasingly decentralised model, as capacities were developed and scaled, and also raised the demand for new capacities. Initially, the configuration for deployment was of a district based system where the DHIS2 was deployed on the state server and data entry done at the district level because of internet restrictions for the sub-district levels. Later a hybrid model was adopted where offline DHIS2 was established in all the PHCs in the state, and data entry done offline there, and then the monthly data exported to the district into the online database. As the internet became more available, data entry started to be done online from the PHC level, making Kerala the first state in the country to have such a decentralised structure for data entry and reporting. The three different models of networks are given below.

**Model-I: District based deployment model: Enabling rapid scale deployment (Figure 10.12)**

The first phase of the district based deployment model enabled rapid scale deployment to the whole state by leveraging on the existing infrastructure and resources, such as internet availability in the different district headquarters in the state. By deploying
DHIS2 at the state level with district access, staff could enter online their consolidated district data into the state database allowing state planners to view data with an overall state coverage. Further, this model helped to test out the technical system and build capacity of state level users, who could then become master trainers to spread of capacity to district and sub-district level users.

Model 2: Hybrid deployment model: Combination of offline and online systems (Figure 10.13)

Most of the health facilities, including in Primary Health Centres and District Hospitals had computers at their stations with limited or no internet access. The HISP facilitators installed the offline version of the DHIS2 on these computers, and the health staff was trained to enter their routine data in these systems on a monthly basis, and to transfer it electronically to the district level using either a USB stick or via email. The district staff then imported this data into the district database through the import/export module of the DHIS2, and was then made available to the state level through the online system. Further, the districts would generate feedback reports and send it to the facilities under them. This model helped to overcome the effect of lack of internet connectivity at the peripheral institutions.

Model 3: Complete online deployment model: Complete and decentralised coverage (Figure 10.14)

As internet become more available at the peripheral institutions, the deployment model was also changed. The state HIS application was configured with all the health facilities and their hierarchy with respective username and access for each user from each facility. Through this, the health staff at the facilities could access the online application via internet and enter their routine data, generate their reports, and gradually over time through the support of the HISP coordinators be able to carry-out local level analysis of data quality and their performance.
The collaborative network was made increasingly robust through the creation of a sense of ownership to the system from the users emanating from the participatory processes, leading also to strong inter-personal relationships and “trust” between the HISP coordinators and the health staff, and also more formal means such as mechanisms such as workshops and seminars. Both these modes, helped to build and scale capacity in both the technical and public health dimensions. For example, a faculty member of the public health institution where the DHIS2 workshop was first hosted helped to help anchor HISP India to the local context, and build understanding of local knowledge. His public health expertise was often called upon by HISP to understand local or public health issues. Further, as HISP team members often went to this institution for giving lectures, their ideas around HIS were also circulated to the students who would hopefully use them to expand the networks in the future.

Participation of health workers and field users were elicited in different kinds of settings, with the aim to make the mode of user participation to extend beyond its instrumental role of creating efficiencies and making system improvements to a more constitutive role where users started to take ownership of the system and direct the use of the system towards their needs.

While there were various ongoing and physical means of developing more formal participatory mechanisms such as workshops, training programmes, meetings and demonstrations, and informal relations with users, technology was also a key vehicle to foster these networks through forming an arena for mutual learning and collaboration. The use of websites, online resources, email and chats helped to develop the crucial
role of social capital as a means to both draw upon local support and to provide a way to spread local understandings. The DHIS2, which had by then developed a large community of users, served as a boundary object shared by multiple actors; users, developers, politicians and others, as a vehicle for shared learning to which social capital development and its transmission took place.

The collaborative network was made robust by strong political support received by both the state level administrators and also the Minister of Health who held a strong sense of pride for Kerala to maintain their primary status in the country with respect to Public Health indicators. A combination therefore of various processes and structural conditions contributed to the growth of a collaborative network, which arguably strongly contributed towards a strong capacity in Kerala, leading to it being ranked Number 1 in the country on “readiness to use information for action” in a national workshop in 2009.

In Table 10.2 the nature of the collaborative network is summarised for Kerala including the key actors and their role in the network.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Key actors</th>
<th>Role in the network network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative Network</td>
<td>Female health workers called JPHIN</td>
<td>Creators and users of local knowledge</td>
</tr>
<tr>
<td>“Multi-level and decentralised”</td>
<td>Public Health educational institution</td>
<td>Strengthening of public health knowledge</td>
</tr>
<tr>
<td></td>
<td>HISP India</td>
<td>Implementation and systems development intermediaries</td>
</tr>
<tr>
<td></td>
<td>National Health Systems Resource Centre</td>
<td>Providers of national legitimacy to HISP India</td>
</tr>
<tr>
<td></td>
<td>State policy makers</td>
<td>Support for open source software</td>
</tr>
<tr>
<td></td>
<td>Oslo DHIS2 group</td>
<td>Translating local knowledge into systems solutions</td>
</tr>
<tr>
<td></td>
<td>DHIS2</td>
<td>Software solution inscribing local knowledge</td>
</tr>
</tbody>
</table>

The Kerala example helps to emphasise the following aspects of the role of collaborative networks in the building and scaling of capacity.

1. Building of collaborative networks: The process of building participatory networks was partly a function of design, and also shaped by situational exigencies. The initial set-up was crucial in shaping future trajectories. HISP India played a crucial mediating role in the building of the network, using opportunities the context provided.

2. Context sensitivity: The context was extremely important in shaping both the initial set-up of the collaborative network, and also its growth. For example, in Kerala the history of the Left rule and culture of decentralisation and participation helped to set-up a network that was broad based, decentralised and pervasive. In such a context, the emphasis on local and public health capacity gained emphasis.

3. Focusing on larger scale HIS outputs to include multiple levels of users in the participatory approach – and not only on local participatory action: While the
prototyping methodology for DHIS2 was used extensively, it was not isolated from what was being tried to be achieved – which was to create a robust state wide HIS. The techniques were thus tied up with the outputs, and the nature of outputs shaped how the techniques were used. The end, and its integration into the context of use, was an important aspect of the participatory process followed.

4. Inculcating a judicious mix of both behavioural and structural aspects of participation: Enrolling various actors in the network required work both on the structural and behavioural dimensions. Without the structure of a network in place, actors could not link with each other, share experiences and ideas, and reach out to the peripheral workers. A primary behavioural focus was on building awareness on the notion of “information for local action” and show how this works in practice. Building such an orientation and acceptance of it is necessarily a long term task, as there are legacies of “upward reporting systems” inscribed in the institutional culture. But with the structural aspects of the networks in place, this process of behavioural change could be cultivated over time.

The above discussions help to illustrate the multi-dimensional efforts required towards building and scaling capacity to help facilitate the eventual translation of data into information and based on it, action. This translation is neither a simple linear “requirement input-application design – application adoption/use” activity as envisioned by most technocratic approaches, nor a tool providing “data on click of a button” as it usually relates to supporting the expectations at the user end. This makes implementation and its scaling a complex, often chaotic, process involving the interplay of stakeholder perceptions, understanding, agendas, contextual conditions, initiatives and pro-activeness that shapes what requirements are a priority, how they are ‘designed’ into the application and how the outcome of these development efforts are eventually utilised. This interplay is further compounded by the fact that stakeholders’ understanding and response to the HIS initiative is embedded in their respective knowledge domains, i.e. representing the know how of how to do things the ‘right way’ or understanding gained through experience and further enhanced and distributed in the process of appropriation and use. These expectations are hopefully effectively supported by the computer based systems. Broad based stakeholder involvement in ‘collaborative networks’ and such multi-levelled participatory design serves two broad purposes:

1. **Instrumental** in promoting the initiative through shared learning and building of the purpose and vision of the HIS initiative and in the process influencing stakeholders in the network. For example, in this case, the decentralised political vision in the state was compatible with the “information for local action” ideology of HISP, which shaped processes of state taking ownership and promoting the scaling of systems.

2. **Constitutive** by way of endorsing certain knowledge, practices, structures and use which in the long run contributed to shaping the knowledge domain of the concerned stakeholders, while ensuring the translation of data into action for purposes of making public health improvements. For example, the bottom up approach of creating and supporting local capacity was inscribed in the strategy for field nurses, who were not only taught about how to use the software but also on the meaning of the data elements, how they are converted to indicators, and how could data quality be strengthened locally.
Further, the cultivation of collaborative networks is facilitated and scaled through the role of Social Capital which represents a network ties of goodwill, mutual support, shared languages, shared norms, social trust, and a sense of mutual obligation that people can derive value from being a member of a society or community. By being a member, people have access to resources that are not available for non members (Huysman and Wulf 2004). This capital, though often coloured by informal vested interests, can be built by presenting the value a stakeholder can get in relation to their respective (formal) agendas and goals. By drawing upon social capital to address local problems, local capacity is both generated and transmitted.

10.2.2 Building and scaling capacities: the cascading approach of “master trainers”

Typically, a health system is structured in a hierarchical manner, with successive levels of the national, state/province, district and sub-district. Promoting local capacity requires reaching out to the sub-district facilities, and equipping them on the multi-faceted dimensions of technology, public health and implementation context. Given that the number of sub-district facilities in a health system would typically range in the thousands, building capacity at that level is nearly impossible for one agency to do and requires equipping the system itself to carry-out this task. This can be done through a cascading approach of “master trainers.” These master trainers are typically from the system, based at the national, state, district or block levels who are then imparted specialised and continuous skill building interventions from the external agency so that they can train others. By being part of the system and based onsite, the possibility of scaling efforts is much more feasible, and helps towards building stronger internal capacities in the system. The cascading occurs when the external agency may start by building capacity of a specialised group of national level trainers who in turn by equipping a larger group of trainers at the province/state level, and then they together build capacity of district trainers. Through such a process, at each level more and more trainers are enrolled.

There can be varying approaches to creating master trainers in the system. In the example of Kerala given earlier, the HISP India coordinators by virtue of being based in the district, even though not being internal to the state, served as master trainers. The idea being that gradually and over time, they would build capacities of a core group of district and sub district users, who could progressively take on the role of master trainers. The risk with this approach is that the state staff because they feel comfortable with the external trainers do not take on the responsibility for themselves playing the role, raising the challenge of ownership and sustainability. In an alternative approach, the strategy could be of creating a strong core group of internal state master trainers, who initially supported by an external agency could impart training to their state teams, but over time would gradually assume independent responsibility. The risk here is of very slow speed of scaling, especially, given the fact that they also have other responsibilities in the system, not just being master trainers.

While the above describes different structural approaches to creating master trainers, the further issue is of the specific content of training that needs to be imparted which should cover technical, public health and implementation related issues. For example, training content on the technical side needs to include skills to carry out DHIS2 customisation and how they could create users, manage servers and various other tasks. On the public health side, skills to be included related to understanding of data
elements, definitions, indicators, and how to analyse, interpret and use information. Further, master trainers need to be coached in how they can create similar teams at lower levels, and also the specific technical and public health related capacities. The success or not of such a strategy is also dependent on broader institutional conditions such as whether the system can manage to designate dedicated master trainers, and include this responsibility as a part of the formal job description. This, is often not possible due to reasons of bureaucracy, such as the challenges in changing formalisations of job descriptions, roles and responsibilities.

In Table 10.3 some focus areas of content for building capacity are summarised.

<table>
<thead>
<tr>
<th>Knowledge Domain</th>
<th>Content of training program</th>
</tr>
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<tbody>
<tr>
<td>Technical domain</td>
<td>• Capacity on local customisation.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Capacity on using data analysis tools such as Dashboard and pivot tables.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Capacity to do basic troubleshooting of technical problems, such as allocating access roles to respective users.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Capacity to use visualisation tools such as GIS.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Capacity to understanding data element and indicator, including their definition, correlation and significance in use.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Capacity around understanding data element behaviour with respective to other related data elements.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Building capacity around interpretation of data and its use in local planning.</td>
</tr>
<tr>
<td>Public health domain</td>
<td>• Capacity to define locally relevant indicators and validation rules.</td>
</tr>
<tr>
<td>Context of Implementation</td>
<td>• Establishing procedures around the data flow and verification.</td>
</tr>
<tr>
<td>Context of Implementation</td>
<td>• Understanding the work practices around different types of health facilities towards data collection and information process.</td>
</tr>
</tbody>
</table>

This identified content needs to be packaged and distributed in the form of training manuals, a set of which can be designated as the "HIS Tool Kit." This includes:

1. Data Dictionary – describing meaning, definition and use of data elements, and also including a comprehensive list of datasets in the national HIS. Basic principles of data, such as the difference between data recording and data reporting need to be articulated in this dictionary.

2. Indicator Dictionary – describing indicator definitions and how they should be used. The dictionary described key indicators identified for different levels (from national to facility) of the health system. The indicators need to correlated to the data elements required, helping to design a more action led HIS.

3. Basics of computers – a user manual. Since many of the health users may have not worked with a computer before, a computer manual can be compiled to provide basic guidelines on computer use, describing different parts of the computer such as keyboard and mouse, and basic operations such as switching on and off the computer.

4. Using DHIS2 – training manual to provide a user guide on the HIS. A CD with the source code of the DHIS2 can be provided to users and with it an installation manual. Obtaining the source code can help the users to feel empowered with ownership of the application, in itself a unique experience.
Using information for local action – training manual which describes basic concepts (such as the information cycle) on how to move from data to action. The principle of the “information cycle” can be described, including the role of the software in supporting each step of the cycle – data collection, cleaning, analysis, visualisation and action.

Building and scaling of capacity will require the large scale dissemination of this tool kit to the user community. This tool kit can then became an effective mechanism in growing the collaborative network by it being used in training programmes both as a template for content, but also through the training to see how it can be further enhanced in new versions to better reflect emerging training needs. These documents would also need to be translated to the local language to increase its relevance in supporting larger scale use. The tool kit can become an important “boundary object” that can help to enrol and support diverse actors in the network, and strengthen their skills to become active participants.

**Summary**

1. The three key facets of local capacity with respect to HIS include:
   a. Technological,
   b. Public health, and,
   c. Implementation context.
2. Technological capacity includes skills to conduct some of the following tasks:
   a. Capacity to carry-out local customisation.
   b. Capacity to use data analysis tools.
   c. Capacity to carry out basic troubleshooting of technical problemmes.
   d. Capacity to use visualisation tools such as GIS.
3. Public health capacity includes skills to carry-out some of the following tasks:
   a. Capacity to understand data elements and indicators, and their significance in use.
   b. Capacity around understanding data element behaviour.
   c. Capacity to develop interpretations of data to help design local action.
   d. Capacity to define locally relevant indicators.
   e. Capacity to define local validation rules.
4. Implementation related capacity includes skills to carry-out some of the following tasks:
   a. Establishing procedures around the data flow and verification.
   b. Understanding the work practices around different types of health facilities towards data collection and information process.
5. A key strategy to build and scale capacity is through the mechanism of developing collaborative networks.
6. Social capital is an effective mechanism to build capacity.
7. The strategy of master trainers is often used in the health sector to build and scale capacity at the system level.
References
