



Contract no. 034106



**Delivering Inclusive Access for Disabled or
Elderly Members of the community**

INSTRUMENT: STREP

PRIORITY: FP6-2005-IST-5

***Final Activity Report – Annex I
Adoption Scenarios for Service and Application Providers***

Unrestricted.

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Revision History

Version	Date	Amended	Reason
V0.1	17/5/2010		Initial draft
V1.0	18/6/2010		Final version
V2.0	14/9/2010	Sections 1.1, 1.1.3 and 1.1.4 and Appendix B	Changes and addition after review with the EU Commission

1. Introduction

The purpose of this annex is to describe how different service and application providers might adopt DIADEM technology with the tasks and costs that each type of organization would face. The discussion presented here is based on the deliverables describing the system architecture (from work package 4) and the business models (work package 9).

DIADEM is assistive technology that provides “client side” support to a web browser by monitoring the user’s interactions during form filling activity and dynamically offering help or personalisation of the interface to optimise assistance for that specific user. The DIADEM software sits in the channel between the browser and the application service so that it can monitor and enhance the user interaction with the application.

An overview of the DIADEM system from the perspective of a single application provider is shown in Figure 1. This scenario has three important stakeholders: the End User, the Application Provider, and the DIADEM organisation. The obvious difference from the normal scenario is that the End User interacts with the online Application through the DIADEM service instead of interacting directly with the online Application.

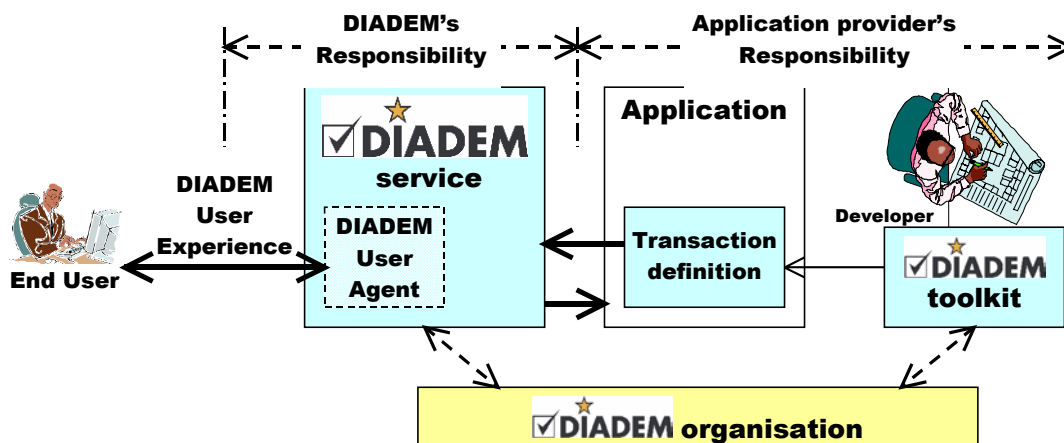


Figure 1 DIADEM overview

The DIADEM core concept is of a system that supports the user when filling out electronic forms. DIADEM receives a transaction definition from the application, interacts with the user to get the required data and then submits the data back to the application.

The Application Provider is responsible for specifying the *content* of the transaction form(s), i.e., what questions and information are to be presented to the End User, how it is logically structured, and what data needs to be returned to the Application. A critical difference when using DIADEM is that application developers are not allowed to specify *presentation* aspects of the form.

DIADEM, as an organisation, is responsible for creating the toolkit, for defining transactions, and run time service software and for supporting the service component deployment where it can be accessed by both end users and application providers. A single runtime service would only be effective in the short term and it is envisaged that multiple “DIADEM authorities”, which run the service component, would be established in the longer term.

The DIADEM organisation will need to support application provider registration to ensure uniqueness of transaction type identifiers (a security mechanism). To ensure a revenue stream, to support software development and maintenance of the service, the DIADEM organisation will use both licensing and pay-per-use business models.

Since the deliverables from the project are confidential and this document is intended for wider circulation the rest of this introduction briefly describes the DIADEM system architecture for those unfamiliar with the earlier documents. The remaining sections present two series of scenarios describing how various types of organisation would engage with DIADEM and the investment they need to make in setting it up. The first series of scenarios looks at the role of application providers and the second series looks at the role of DIADEM authorities.

1.1 DIADEM System Architecture

DIADEM is not a single standalone application but a set of components as shown below in Figure 2. Any particular disabled user (for example Y) will access several different applications (for example A and C) and expect to see them presented in the same way when accessed through the DIADEM service component. Also a particular application (for example B) may be accessed by several users each needing the system to personalise the application B “Forms” in different ways as defined by their profile data.

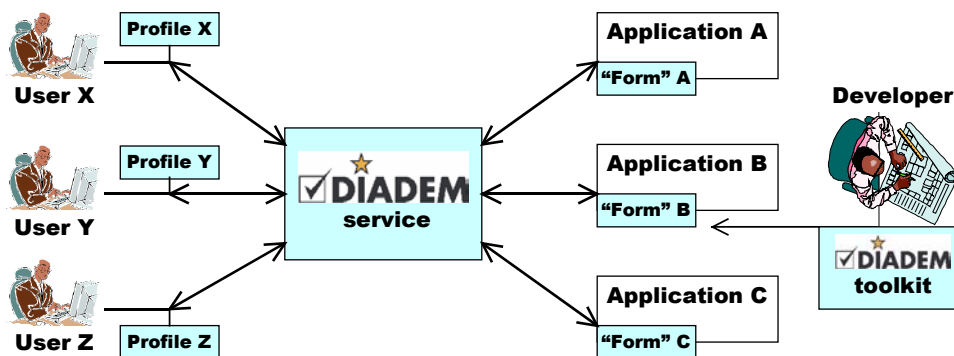


Figure 2 DIADEM Component Architecture

In order to deliver the DIADEM functionality to support a transaction or interaction with an application all three of the components – profile, service and transaction (“forms”) – need to be present. These components are not necessarily co-located on the same user or application provider site and in general different organisations will be responsible for supporting them. In addition, DIADEM includes a developer toolkit for creating the transaction description data or “forms” to go with each application.

All connections between the browser, the profile storage and the DIADEM service component use SSL encryption to protect user data.

In discussing the architecture and scenarios in more detail it is necessary to make distinctions between such things as forms and transactions and between application and service providers.

1.1.1 DIADEM service

The DIADEM service software is the active component that carries out the monitoring, support and personalisation operations. It is responsible for creating the precise appearance and behaviour of the transaction as experienced by the user. It is also responsible for providing a single sign-on capability for the user and for handling the End User's profile data.

The DIADEM User Agent) is responsible for direct interaction with the End User part of the service. To do this it needs to be physically present on the user's computer system. The User Agent is implemented using Web 2.0 AJAX technology and downloaded as required without needing any specific action from the user.

Although the complete DIADEM service can be implemented on the End User's computer, the service component does not need to be located there. Also, since DIADEM will be used to access several different applications, most application providers would not want host the service component and end up supporting other application providers. One solution to this will be to make the DIADEM service component (including the downloadable User Agent) available as a service on a Cloud computing platform.

However, we envisage that a wide variety of other organisations would have reasons for hosting DIADEM service components and these are discussed below. For simplicity, any organisation that opts to install and operate the DIADEM service on behalf of some user group (large or small) is referred to as a DIADEM authority.

1.1.2 DIADEM transactions

For each application to be accessed through DIADEM the application provider needs to have one or more DIADEM transaction definitions, which specify the "forms" or needs of the application. Unlike conventional HTML or web-based forms each definition covers all the interactions needed for what the *user* would perceive as the complete interaction needed to obtain a good or service. A DIADEM transaction will often need several existing HTML forms to be combined into a single transaction in the same way that conversion to Web 2.0 AJAX technology is requiring developers to rethink transactions.

Creation of these XML files, along with any supporting image and sound files, are the main task necessary for an application provider to adopt the use of DIADEM. These files would normally be co-located with the application on the application providers website.

1.1.3 DIADEM profiles

For each disabled or elderly user there is a stored profile, which holds their identity, single sign-on data and other information to personalise an interaction to their needs. Irrespective of the number of applications and organisations a user interacts with they have only one profile, which is used for all interactions. This profile includes sensitive personal information and ensuring adequate security of both the profile data and any data transmission is critical.

Profiles may be stored in any of the following locations:

- The profile may be carried by the user by storing it on a token or smart card.
- The profile may be stored on the user's personal computer.
- The profile data may be stored by a DIADEM authority as part of the service they offer.

Note each of these options has different security implications and the choices may be different for users who access applications through the same DIADEM Authority. The user's choice also affects how they are identified and how the initial profile is set up.

Applications can add user data, like an account number, to a profile so that it can be filled in next time they use the application. For security reasons data is tagged with the source application identifier and can only be retrieved in forms that belong to the same application group. The data is prefilled on the screen, not part of hidden fields, so the user always sees what is entered in this way and has the option to override it.

It is essential to give all organisations that use DIADEM a unique identifier so that the DIADEM service component can ensure that one organisation cannot gain access to data from a different organisation. The registration and licensing process described in the

scenarios below ensures that each organisation has a unique identifier and this then keeps data in separate “compartments” and restricts access to data in the profile.

To strengthen profile and data security DIADEM has been designed to make use of PKI services where they are available. DIADEM does not intend to implement a PKI itself but to make use of the services implemented by other competent organisations. The PKI capability is primarily focussed on access to the user profile, where it is held remotely, and providing a strongly authenticated means of user identification. PKI enabled security devices such as tokens or smart cards may also be used to provide a mobile but secure profile store.

1.1.4 Initial Profile Set Up

Wherever the DIADEM service is located each user should have only one profile that covers all sites they access applications on. There are only two ways this can be achieved; first by the user keeping the profile with them on a token or on their own personal computer; and second by having it stored on their internet service providers site along with their mail box. When stored on a token, like a smart card, the token can also be used for identification and authentication. However, DIADEM is not intended to replace everything on the web and in many contexts the current authentication practice would continue to apply but may be much weaker than using tokens.

On first use the DIADEM service software will detect that the profile has not been established and initiate the introduction to the DIADEM system. This presents an audio visual introduction to DIADEM and then it presents a data entry form to collect initial profile information. Once this is done and the profile is saved DIADEM presents the application form to fill in. The profile updates each time DIADEM is used but this induction process only occurs on the first use.

1.1.5 DIADEM toolkit

This component is not part of the run time environment. The toolkit is intended to support consultants, developers and application providers in creating the DIADEM transaction descriptions needed to make an application usable with DIADEM.

One tool is a full-blown Transaction Builder. This tool, like current form builders, enables the interface developer to design a complete transaction (form) on screen with a development environment tailored to DIADEM’s needs. Not only does this ensure that the transaction description is well formed and complete, but it also prompts the developer to follow appropriate accessibility guidelines in creating the transaction.

Another tool envisages the creation of transaction component libraries or catalogues of standard designs for use across multiple organisations. In this case, the application provider will not do complete transaction designs but they will download the predefined transactions, or transaction components, that they need from the catalogue. These could be imported into the main tool kit as initial designs to be modified. Alternatively, they can be used with the second tool to perform limited customisation with the individual application provider’s registration details and other parameters such as company names, addresses and logos. It will present a wizard like interface and be no more complex than using a simple installation tool.

Both of these tools will be made available as components on the Cloud computing platform along side the DIADEM service component. They may also be installed locally by application developers intending to make significant use of them.

2. Application Provider Scenarios

In this section five application provider scenarios are examined. Note that the critical issue for application providers (see Figure 1 above) is creating transaction definitions for their system not running the DIADEM service components. Provided service components exist somewhere, they only need to make their systems interface with those components. The adoption decisions are expected to come in waves as the case for DIADEM penetrates different market sectors.

Market penetration for DIADEM is expected to start with public bodies because of their need to serve the whole community and their commitment to support of the elderly and disabled members of the population. There is an increasing tendency to make accessibility a statutory requirement, at least in the public sector. For example, Italian law requires every local body to satisfy some very strict accessibility rules. The DIADEM system fits in very well with the Italian regulations for public Internet sites and will help authorities comply with them. We also expect early promotion from charities and support groups for the elderly, who will use DIADEM on their web sites and services. This gives us the first scenario addressing municipal and local government agencies with multiple responsibilities including social care services.

Other application providers will probably adopt a wait and see approach to DIADEM as a system. However, two adoption pressures are foreseen. First, the early adopters will be creating public awareness and, in turn, market pressure for other application providers to offer the same quality of access. Second, given the physical limitations experienced by elderly members of society they have more reason to seek online services rather than go physically to the provider's premises,

Large complex applications will be harder to make DIADEM ready and users of bespoke applications software will have to bear the whole cost of creating transaction definitions for their systems. We therefore expect the next wave of adopters to be SME's providing simple basic services using generic application software. The majority of the large application providers will be in the third wave. Our next three scenarios follow these waves:

- Generic application providers.
- SMEs providing a single type of good or service to the community.
- Large applications providers with multiple services or more complex service offerings.

This leaves a group of online services that loosely fit the notion of social networking sites, which don't follow the direct revenue-generating model that links income to transaction volumes. Here the cost benefit analysis, where DIADEM licence or pay-per-use fees can be set against increased transaction volumes and correspondingly increased revenue, is unlikely to be favourable. However, adoption by these sites can be seen as beneficial both for social reasons and supporting them as early adopters increases the momentum for DIADEM. This gives us the last scenario – social network hosting services.

In describing these scenarios we give specific estimates of the effort required and the costs we expect to be incurred. The basis for these estimates is discussed in Appendix B.

2.1 *Municipal and local government agencies*

It is expected that government agencies will be early adopters of the DIADEM technology. They will not only make their applications DIADEM accessible by creating transaction definitions for them but they will also consider leveraging their investment by becoming DIADEM authorities to support their local community (see below).

Early public sector adoption can be justified because these authorities have a social service mandate to support all members (including disabled members) of its local community.

Typically, UK borough and district councils provide 60 to 70 online accessible services to local citizens and they will have over 100 different online forms defined to deliver those services. However, very few have separately invested in creating these systems. Most authorities outsource their ICT service provision to an application provider specialising in local government services. For example, according to the eGovernment Register¹, only 7 of the 290 UK local authorities reporting the use of e-Forms software have an in-house solution. The remainder use one of the 16 suppliers of e-Forms for UK local government and Sheffield's supplier, Firmstep², is responsible for the system used by about 100 local authorities.

The situation varies across Europe and in Italy, for example, the vast majority of online services are provided by municipal authorities. However, the range of services varies according to the population. Smaller municipalities will offer very minimal service – mostly directories and useful information – but bigger ones (over 20,000 inhabitants) offer a wide range of e-Forms for citizens, such as request of certificates, fee and local taxes payment, database queries, appointment bookings with public officers, feedback forms, etc, with an average number of 42 e-Forms for each big city council.

Other kinds of service, mostly aimed at business and other local administrations, are offered by wide area authorities such as the Provinces and Regions. Here the number of services increases according to the much wider population serviced, so the average number of services is above a hundred, for example the Piedmont Region offers 180 services.

As in the UK the vast majority Italian authorities outsource to an ICT provider, such as CSI Piemonte.

A typical scenario would be an e-Forms provider undertaking to adapt its products for DIADEM access and the adoption of this solution by some 20 or more local authorities.

It is assumed that the forms in use are reasonably consistent with those used in the DIADEM project and that the only interaction with the application needs to be the support of a postcode address finder and validation that the user is within the authorities jurisdiction. Some, but not all, forms will need to be submitted by users registered with the authority and some will be related to payment services.

2.1.1 Set up activities

The e-Forms provider will need to make some limited modifications to their core systems and there will be a need to do work on behalf of each authority because the generic applications are generally configured specifically for each customer.

2.1.1.1 Common e-Forms provider tasks

It is assumed that the provider organisation employs experienced technical staff and that appropriate training, documentation and support is provided by the DIADEM organisation.

1. Register as a generic application provider.

¹ The eGovernment Register (<http://www.brent.gov.uk/egr.nsf>) is a unique collaborative environment for UK local authorities and private sector suppliers. It provides up-to-date information on a variety of e-government activities including product usage, tenders and partnerships.

² Trade name of Business Web Software Ltd (<http://www.firmstep.com>).

2. Acquire the DIADEM toolkit software and staff training for 3 staff (10 days)
3. Develop web services interfaces for the postcode address finder and validation that the user is within the local authority jurisdiction. Since the functionality is already present with the current system implementing an idempotent interface as a web service should be no more than 5 days effort per function.
4. Modify the core application interface so that user authentication (login data) can be provided concurrently with the transaction data for services restricted to registered users and create DIADEM transaction templates for the user registration and account maintenance processes. Assuming well-founded modularisation of this functionality in the existing system this should require no more than 15 days effort.

Some local authorities will wish to make use of Public Key Infrastructure (PKI) enabled smartcard authentication systems. Some additional work may be required to integrate existing PKIs or make provision for proposed services. Provided these services meet with internationally agreed standards the integration of PKI enabled authentication services should be no more problematic than for other services³.

5. Set up the necessary interface components and links for accessing banking and credit card payment services. It is assumed that, because many application providers need payment services, the DIADEM organisation will have agreed procedures with the various payment systems and that the e-Form provider will only need to follow the guidance coming from DIADEM and the banking organisation. The estimated effort required is 5 days.
6. Using the toolkit develop templates for the other forms commonly used by across many local authorities. It is assumed that this will cover 75% of the portfolio of forms on any one local authority site. Given the level of form complexity and common content this will average 2.5 days per transaction. It is assumed that there are common elements shared between transactions and DIADEM will support include mechanisms so that they only need to be defined once. The estimated effort required producing 75 transaction definitions is 185 days.
7. To record and edit professionally produced sound files for all the form texts within this transaction set at an average of ½ day per transaction. It is assumed that the local authority would opt for a recorded voice rather than speech synthesis because of the more acceptable experience it generates. The estimated effort required is 40 days.

The total effort to modify the e-Forms application interface and produce 75 generic eGovernment transaction templates would be about 265 days or 13¼ person months. With a 3 or 4 person team on the project it would take about 4 months to have the core e-Forms product DIADEM ready.

If the e-Forms provider already has a form generation system that stores data describing forms in some structured way it may be possible to modify the existing system to export initial transaction definitions. If modification to export the DIADEM transaction definitions take 30 days and that this halves template production at stage 5 above, the total conversion

³ The experimental DIADEM software was trialled in Sheffield with Smart card identification but not PKI. Sheffield's consultant on smartcards and secure authentication has indicated that DIADEM poses no particular challenges with PKI and we anticipate that the DIADEM organisation will supply PKI compliant versions of the DIADEM service component as part of its normal business activity.

time is reduced by just under 3 person months making the total effort about 10½ person months.

2.1.1.2 Per local authority tasks

Assuming each local authority needs about 100 transaction definitions mostly derived from the templates above the individual implementation and set up tasks, undertaken mainly by the e-Forms provider, will be:

1. Register as an individual application provider.
2. Customise the commonly used transaction definitions. The estimated effort required is 23 days.
3. Define the 25 authority specific transactions and record supporting sound files. The estimated effort required is 87 days.
4. Modification of static web content to make links to the DIADEM service as alternatives to the current forms. Estimated effort 10 days. This assumes that the web site is operated with some form on content management system and that it is not necessary to modify individual HTML pages one by one.
5. Training for local authority help desk staff (5 days).
6. Installation and switchover (5 days),

The total effort to modify the service at one local authority would be 130 days or 3½ person months. With two staff engaged on the project it would take about 2 months to have the local authority site set up with DIADEM enabled forms.

2.1.2 Set up and operational costs

In determining the overall costs it is assumed that the e-Forms provider amortises their set up costs over 20 authorities. Thus, their fee would be based on about 4.2 person months of consultancy plus 5% of the fees paid to the DIADEM organisation for the toolkit, training and support.

This gives a start up cost for an authority like Sheffield City Council of €40,000 to €55,000. Note this assumes about 1 person month of their own staff time plus fees paid to the e-Forms provider.

Once set up, the operational cost is expected to be minimal. The transaction definitions and supporting files are static content that the DIADEM service will retrieve from the local authority web server with standard HTTP requests. During the DIADEM trials a single form required 13.8 Mbytes of storage. However, most of this is the recorded sound files, some of which would be shared between several transactions.

The estimate storage demand for 100 DIADEM transaction definitions would be 1 Gbyte with transmission demands of 14 Mbyte per transaction access. In addition the authority would pay a blanket licence fee per annum rather than per transaction fees.

On an estimated 125,000 DIADEM transactions per year (5% of the local authority total) the operating costs would be about €50,000 – about 0.3% of the ICT budget (€16M).

2.1.3 Expected Benefits

The expected benefits for the e-Forms provider are an improved service offering for the public sector and additional revenues for creating and supporting DIADEM enabled applications.

For each local authority the expected benefits are improved user satisfaction, greater use of online services by these traditionally difficult to service user groups and improved quality of data input leading to less effort expended on following up and correcting erroneous data. Crucially DIADEM will deliver these benefits and at the same time it will enable local authorities to meet mandatory central government targets for social services and e-inclusion.

2.2 Generic application providers

The scenario here is not dissimilar from the picture with the e-Forms provider above. However, here we consider organisations that supply of the shelf e-Commerce web site packages like WP Shopping Cart⁴ or Comersus Cart⁵. This scenario also applies to other common businesses like property agents, event bookings, or service requests, where there is a reasonable market for off the shelf solutions.

2.2.1 Set up activities

It is assumed that these organisations will take a pragmatic approach to setting up the system for DIADEM access by choosing to use the pay-per-use toolkit on the Cloud-computing platform and speech synthesis rather than recorded speech.

1. Access the DIADEM toolkit software and familiarisation for 1 person using online tutorials. (2-4 days).
2. Locate and download common transaction components (postcode address finder, online payment etc.) from the library provided by the DIADEM organisation. This is application dependant but should require no more than 2 days effort.
3. Register as a generic application provider. Note the Cloud computing model allows access on a trial basis before making the commitment and registration.
4. Use the toolkit develop templates for each transaction – checkout, register account, follow-up or cancel order etc. It is assumed that a single application will need about 6 relatively simple transactions. Given the variable level of competence and limited exposure to DIADEM transaction development it is assumed that the first two or three transactions will need about 5 days each but the rest can be developed more quickly, The estimated effort required producing 6 transaction definitions is about 20 days.
5. Since DIADEM can mimic the return of data from HTML forms no modification to the core application maybe necessary. However, the time will be needed to review this and some minor modification may be required. It is assumed that this activity will require no more 5 days effort.
6. The final task will be making the extended product available by setting up the necessary interface components, links for accessing payment services and making templates available for customisation. It is assumed that effort required is no more than 5 days.

The total effort (and elapsed time) to modify a generic application like a shopping cart will be about 2 months.

⁴ <http://wordpress.org/extend/plugins/wp-e-commerce/>

⁵ <http://www.comersus.com/hosting.html>

2.2.2 Set up and operational costs

The set up costs will be 2 person months time plus the pay per use fee for the DIADEM toolkit and download fees for transaction elements from the DIADEM library. At nominal employment rates this makes the total cost €10,000 to €20,000. If the product is distributed for licence fees then the staff cost is comparable with other maintenance activities, and would be recovered in the normal course of business.

If the product is a not-for-profit or freeware venture then the decision to invest staff time would compete with other suggested enhancements within the developers consortium. In these circumstances the DIADEM organisation may discount or waive toolkit charges because it will recover income from increased market penetration in the use of DIADEM and pay-per-use fees from the DIADEM service.

2.2.3 Expected Benefits

The expected benefits for generic application provider are an improved service offering and possible additional revenues for hosting and customisation. By offering expertise and services built around the DIADEM system, a generic application provider can also supply better quality online services, making them more accessible and thus enabling their clients to target a wider number of users.

2.3 Single service SMEs

Small single service SME's usually have a simple Internet presence with a web site providing company information and a limited number of services. In many cases, they operate common services like sales, property agents, bookings, or service requests. It is assumed that these organisations don't have their own technical staff and that they use either a generic application package or a bespoke solution provided by a consultancy service.

2.3.1 Set up activities

As above it is assumed that these organisations will take a pragmatic approach by choosing to use the pay-per-use model with the Cloud-computing service and speech synthesis rather than recorded speech.

Where the business uses a generic application setting up their service to use DIADEM will be dependant on the generic package supplier making appropriate extensions to the package available. The others, using bespoke systems, will need their supplier to follow the same sort of procedure as the generic application provider to modify their bespoke solution.

2.3.1.1 Generic application users

In these cases, the SME only needs to register as an individual application provider and then install the updated application from the generic provider. It is assumed that they need to do some configuration of the transaction definitions to add their registration, company names and addresses, etc. This would be done through a configuration wizard and would be no more complex than any other application upgrade. Say 3 days at the most.

2.3.1.2 Bespoke application users

In these cases, the SME needs to have their consultant or supplier upgrade the software and it will involve paying consultancy fees to get the system upgraded. The activities undertaken by the consultant would be:

1. Register the SME as an individual application provider.

2. Access the DIADEM toolkit software, familiarisation, and downloading common transaction components from the library as above (5 days).
3. Using the toolkit to define about 6 transactions, checking that data can be mimicked by HTML form and any minor modification to the application as above (25 days).
4. The final task will be installing the definition files and adding appropriate links on the web site. It is assumed that effort required is no more than 5 days.

The total consultant effort (and elapsed time) to modify a reasonably straightforward bespoke application will be about 2 months plus SME staff time spent in liaison activities (no more than 5 days).

2.3.2 Set up and operational costs

2.3.2.1 Generic application users

The charges for the application extension depend upon the business policy of the generic application provider, but we would not expect their upgrade fee to exceed 10% of their costs. Most of the cost to the SME will be their own staff time. Thus, the total cost for an SME using a generic application to set up DIADEM should not exceed €2,000, and in many cases we would expect it to be less.

There will be an operational need for the static storage and transmission of transaction definitions and supporting files (about 1 Mbyte storage and 200 Kbytes per transaction). This is comparable with existing online forms and should have no net effect on the website's hosting cost.

The main operational cost will be the pay per use fees recorded by the DIADEM service for handling transactions. This would be €0.5 per transaction.

2.3.2.2 Bespoke application users

In determining the overall costs it is assumed that the fee would be based on about 2 person months of consultancy plus the fees paid to the DIADEM organisation for use of the DIADEM toolkit and download fees for transaction elements from the DIADEM library. Assuming reasonable salary rate for SME liaison this gives a start up cost of €8,000 to €15,000. Given that the organisation has opted for higher bespoke application costs this is believed to be an acceptable figure.

The operational costs will be the same as for the generic application user.

2.3.3 Expected Benefits

The expected benefits for these SME's are improved user satisfaction, greater use of online services and improved quality of data input leading to less wasted effort dealing with incorrect data, returned goods or correcting inappropriate service provisions. This should lead to increased market share through increased reputation and better customer retention. The magnitude of the benefit will depend largely on the proportion of their market that comes from the older end of the population.

If the SME provides online services for some kind of local authority that it is obliged to comply with statutory regulations about e-inclusion DIADEM will enable the SME to gain market share by supplying a system with improved compliance.

2.4 Large applications providers

The situation for larger application providers such as super markets, travel agents, transport booking and major suppliers like Amazon.com is more complex. In general, they have bespoke application offering both a greater variety and more transactions types to support their business.

A difficulty here is the progression towards dedicated designs for AJAX services locking the organisations into major interactive designs that may not be appropriate for elderly users. However, if the core applications are based around web services interfaces and XML data transmission producing an alternative DIADEM based transaction interface running in parallel with the bespoke solution is a feasible option.

These are assumed to be high profile businesses that will also opt for recorded speech and have their own help desk staff available to provide telephone support. When they decide to adopt DIADEM, they will make a significant investment to achieve maximum benefit.

2.4.1 Set up activities

This scenario assumes a significant number of transaction types (20-30) but still significantly less than the local authority scenarios. It is also assumed that these will include two or three significantly more complex transactions supporting the core business.

However, we can expect that such organisations will generally have qualified in house staff to maintain their web sites and services. The tasks they will need to undertake are similar to the local authority e-Forms provider as follows:

1. Register an individual application provider.
2. Acquire the DIADEM toolkit software and staff training for 3 staff (10 days)
3. Using the toolkit develop transaction definitions for accessing the application. It is assumed that the 3 core complex transaction will require 10 days per transaction definition but that others are more straightforward and can be produced on a shorter time scale using DIADEM's include mechanisms for common elements shared between transactions. The estimated effort required producing 25 transaction definitions in total is 85 days.
4. Developing idempotent web services interfaces for up to 3 intermediate interactions should be no more than 5 days effort per function.
5. Modify the core application interface so that user authentication (login data) can be provided concurrently with the transaction data, should require no more than 5-10 days effort.
6. If necessary setting interface components and links for accessing banking and credit card payment services. Again, it is assumed that the DIADEM organisation will have agreed procedures with the various payment systems. The estimated effort required is 5 days.
7. To record and edit professionally produced sound files for all the form texts within this transaction set at an average of ½ day per transaction. The estimated effort required is 13 days.
8. Modification of static web content to make links to the DIADEM service as alternatives. Estimated effort 10 days. This assumes that the web site is operated with some form on content management system and that it is not necessary to modify individual HTML pages one by one.

9. Training for help desk staff (5 days).

10. Installation and switch on (5 days).

The total effort for a large application provider to add a DIADEM would be about 153 days or 7³/₄ person months. With a 2 or 3 person team on the project it would take about 3 months to get their web-site DIADEM ready.

2.4.2 Set up and operational costs

The set-up costs would be the in house labour costs plus the fees paid to the DIADEM organisation for the toolkit, training and support. This gives a start up cost of €60,000 to €80,000.

The transaction definitions and supporting files have an estimated storage of about 350 Mbytes with transmission demands of 10-15 Mbyte per transaction access. Given that this type of application provider operates large server banks to support their existing business the operational cost for adding DIADEM transactions to the website is expected to be minimal.

In addition the application provider would pay an annual licence fee at the same level as a municipal authority instead of individual transaction charges. The direct operating costs would be no more than €50,000 but this excludes the cost of the help desk service.

2.4.3 Expected Benefits

As with the SME application providers the expected benefits are improved user satisfaction, greater use of online services and improved quality of data input leading to less wasted effort dealing with incorrect data, returned good or correcting inappropriate service provisions. Again, depending on the proportion older users interested in the particular provision, this should lead to increased market share through increased reputation and better customer retention. For major online application providers this is expected to be a significant revenue stream.

Again, accessibility compliance will give the organisation an advantage in dealing with public bodies and in other markets where it mandated.

2.5 Social network hosting services

The scenario for social network web sites (such as ActiveCiti or Doodle) is almost identical to the supply off the shelf e-Commerce applications (see above). The significant difference is that the organisation hosts the web site rather than distributing of the application for customisation.

2.5.1 Set up activities

It is assumed that these organisations will take a pragmatic approach to setting up the system for DIADEM access by choosing to use the pay-per-use toolkit on the Cloud-computing platform and speech synthesis rather than recorded speech. It is also assumed that since DIADEM can mimic the return of data from HTML forms no modification to the core application will be necessary.

1. As above initial access to the DIADEM toolkit software and familiarisation (2-4 days).
2. The only common transaction component in the DIADEM library that might be relevant here is user registration (1 day).
3. Register as an individual application provider.

4. Using the toolkit to define about 6 transactions, checking that data can be mimicked by HTML form and any minor modification to the application as above (25 days).
5. The final task will be installing the definition files and adding appropriate links on the web site. It is assumed that effort required is no more than 3 days.

The total effort (and elapsed time) to modify a basic social networking web site will be about 1½ months.

2.5.2 Set up and operational costs

In addition to the 1½ person months effort there will be the pay per use fee for the DIADEM toolkit and download fees for transaction elements from the DIADEM library. At nominal employment rates this makes the total set up cost of €14,000 to €16,000.

As above there will be an operational need for the static storage and transmission of transaction definitions which will be comparable with existing online forms and should have no net effect on the website's hosting cost.

Since such sites do not generally receive transaction based revenue a blanket licence fee rather than per transaction fees would be more appropriate. As above, if the networking site is operated on a not for profit or free service basis the DIADEM organisation may discount or waive such charges.

2.5.3 Expected Benefits

The expected benefits for networking site are an improved service offering and possibly additional membership revenues.

3. DIADEM Authority Scenarios

Good performance requires that the delays between the DIADEM service component and the user's browser be minimised to ensure that responses are apparently instantaneous. In part, this is secured by using AJAX technology but feedback that is more complex depends on the service component. Downloading the service component to the user's PC overcomes this but introduces other problems from the variety of browsers and operating system platforms in use. Hence, the DIADEM service component is provided as a network service. In addition to support for the DIADEM service through a cloud-computing platform, other organisations could establish themselves as DIADEM authorities supporting the service component:

- A local government agency (such as Sheffield or Turin) could operate as a DIADEM authority and provide the functionality as part of their services to elderly and disabled users in their community. In the short-term they might also provide the service to leverage their investment as a large scale application provider.
- DIADEM authorities could also be small, localised services like a single server on a library based LAN or for a sheltered housing estate.
- Current domestic ISPs could act as DIADEM authorities providing the service in much the same way as they provide an email service (e.g. <https://diadem.ntlworld.com>).
- Relevant charities could operate as DIADEM authorities. For example Help The Aged⁶ or Alzheimer's Europe⁷.
- Large general service providers such as Yahoo and Google could act as DIADEM authorities (e.g. <https://diadem.yahoo.co.uk>).

Since the DIADEM organisation recovers income from the application providers based on transaction throughput the only charges for a DIADEM Authority will be for training and support.

There is also the need to consider what forms of profile storage are supported. In some cases, the DIADEM authorities will simply support the DIADEM service component but others will provide profile storage as part of the service (see sections 1.1.3 and 1.1.4 above).

This range of provision is covered by just three scenarios

- Municipal and local government agencies
- A localised library service
- A domestic ISP

3.1 *Municipal and local government agencies*

As early entrants, with potentially significant numbers of users local authorities need to be sure that the DIADEM service is readily available with minimal transmission delays. Municipal authorities support local communities and they have a social service mandate that justifies the provision of services that benefit the local population. They can therefore justify the installation and operation of the DIADEM service component.

⁶ <http://www.helptheaged.org.uk/en-gb>

⁷ <http://www.alzheimer-europe.org/>

However, providing profile storage would require systems of user registration and the provision of secure storage maintained on behalf of the user – not the authority. This introduces a new relationship with users and it is harder to justify. The system would therefore work with profiles stored at the local PC. Whether this is on a removable token or local disc storage is transparent to the DIADEM service component.

3.1.1 Set up activities

Set up is simply a matter of downloading and installing the diadem service using the installation tools supplied by the DIADEM organisation. Some configuration is necessary but since there is no local profile storage this is minimal. The effort required would be 2 days at most.

3.1.2 Costs and benefits

The only set up cost is a small amount of staff time.

The operational cost will be storage for the DIADEM service component (less than 50 Mbytes) and transmission costs associated with each transaction. However, as the transaction volume supporting local citizen access to other DIADEM enabled services rises this will eventually give rise to significant traffic volumes unless other DIADEM authorities and a significant the Cloud computing solution also come online.

This solution gives an authority short-term advantage during the initial development of DIADEM by ensuring good quality of service for citizens using its services. It will also leverage DIADEM adoption by providing the support essential for the second and third wave of application providers setting up their systems for DIADEM. How far this goes is a political decision for the authority.

3.2 A localised library service

Another way public authorities and charitable bodies can support their citizens and members is by acting as DIADEM authorities for users on their local building or office network. For example, libraries now provide numbers of workstations for their members.

In this solution the DIADEM service component is installed on the local network server and it only provides support for users on the public workstations. There is no profile storage on the server and profile storage at the workstations needs to be restricted to tokens that users keep in their possession.

3.2.1 Set up activities

Once again set up is simple and the effort required would be 2 days at most.

In this local context staff can be expected to provide support to users who experience difficulties at the workstation. There will be a need to provide some staff training, which might amount to a cost of two or three person days.

3.2.2 Costs and benefits

Adding in the staff training for local support the set up cost would be approximately €3,000. However, neither the storage requirement nor the transmission costs are expected to be significant in this context.

This solution gives is a very effective way to provide a responsive service combined with personal support for users unable to work online entirely independently. The advantage is that it enables an organisation to fulfil social and charitable objectives with the elderly and disabled users for a moderate investment.

3.3 A domestic ISP

If DIADEM gains sufficient penetration as a solution then it raises the question of this type of assistive technology being provided as part of an internet access package in the same way that internet service providers include email, backup services and personal websites. Since ISPs already have strong authentication services and provide storage for sensitive personal data, they are already set up to offer secure profile storage as part of the deal. However, this should not be mandatory and the DIADEM service will work with profiles held at the user's machine.

3.3.1 Set up activities

Once again set up not a major task and the effort required, including configuring the system for local profile storage, would be 5 days at most.

However, it would be inappropriate to offer the service as a DIADEM authority without also making all their own transaction interfaces DIADEM enabled. The number of transaction types seems likely to fall between the SME and large application provider above but none are particularly complex. The set up process would be as described above and need about 90 days effort.

The elapsed time for setting up as a DIADEM authority with internal application also set up for DIADEM access would be between 2½ and 3 months.

3.3.2 Costs and benefits

Assuming all the work is done by well qualified internal staff and taking all the set up activities into account the total cost would be €20,000 to €30,000.

Data storage and transmission costs should not add significantly to the costs of current ISP packages. However, there will be a need for an annual licence fee as above for an individual application provider using DIADEM transactions.

The main benefit for an ISP is the apparent quality of service and usefulness of the package offering. In a market where not all ISPs offer DIADEM support its adoption will depend on the perceived advantage in gaining market share. ISPs as DIADEM Authorities should be able to avoid delays between the DIADEM service component and the browser. They are thus able to offer users good performance and secure profile storage as selling points.

Appendix A. Glossary

Some terminology needs to be clarified.

Application provider: An organisation that offers goods and services to end-users through World Wide Web technology (that is the user normally interacts with the organisation using a web browser such as Firefox or Internet Explorer). This activity of making electronic forms available to users, collecting form data, and processing form data in backend systems may be undertaken in their own interests or on behalf of other organizations.

Application: The collection of software and services (electronic forms, processing and backend systems) that as a whole responds to web browser requests and provides a clearly defined service or set of functions offered by an application provider.

Electronic form or Form: A data structure consisting of fixed content interspersed with placeholders where variable content can be entered, and in which the fixed content conveys the meaning assigned to its associated variable content. The word "form" may refer to the abstract data structure itself or to a particular rendering of that data structure.

Identification device: A piece of equipment that provides identification and authentication of a person, e.g., a fingerprint reader or a smartcard reader.

Internet service provider (ISP): An organisation that provides Internet access to its customers. For example telecommunications companies like British Telecom, Telenor or Virgin Media.

Integrated consumer service: An organisation that provides integrated consumer services to online users. For example Yahoo or Google.

Token: A small portable piece of equipment that can store data like a USB memory stick or smartcard. Note tokens may be combined with identification devices.

Transaction: The complete set of interactions (or forms) that a user needs to complete for an application to deliver a good or service. Unlike conventional HTML or web-based forms a transaction definition is based on the user perception of a single activity and covers all the interactions needed to achieve a goal.

User or End user: A person who uses a computer system (web browser) to fill out electronic forms made available by Application Providers in order to obtain a good or service.

Appendix B. Basis for Effort and Cost Estimates

The software developed during the DIADEM research project was aimed at demonstrating proof of the DIADEM concept in that it could provide effective mitigation of the effects of cognitive decline and support users in the form filling activities. In this form it did not have any of the DIADEM toolkit components that would be produced to support a production version. However, collectively the DIADEM partners have significant experience of the type of tasks required as part of their normal business activities. In particular:

- MORE Software Solutions is a specialist SME with considerable experience in the development of form technology in order to secure the best possible interaction between the users and the forms. They currently support the development of XFORMS and ELMER compliant forms with the type of toolkit that would be deployed to support DIADEM.
- CSI Piemonte is a large provider of outsourced software services to public bodies and undertook specific experiments within which they deployed the experimental DIADEM software during the project.
- Sheffield City Council is a large public authority in the UK that also developed DIADEM forms during the project. Their consultants and web support staff have reviewed estimates for the tasks and scale of operations discussed in this document and confirmed that they are in accord with their experience of such tasks.

B.1 Creating DIADEM transaction definitions

Creating the transaction definitions will be the major activity that application developers will need to undertake to adopt DIADEM as an interface to their applications. The main purpose of the DIADEM toolkit will be to provide the sort of support MORE give to customers in streamlining this process. During the project CSI Piemonte used MORE's product to build an XForms version of a moderately complex existing form. Working with some assistance but without prior knowledge of the product they conducted the task in less than a day. Based on this and MORE's experience with their customers three variations can be anticipated in the performance of this task:

- First it assumed that the work is done by a reasonably experienced form developer who has been trained in the use of the toolkit (see below). They are generating DIADEM transaction definitions for an application they know and creating a basic definition file can be done within a day (like CSI above). However, it will take some trials and polishing to complete the definition to an acceptable standard. The scenarios therefore allow 2.5 days per transaction as average form translation time with trained and experienced staff.
- Second a less professional scenario is assumed where the developer takes no formal training. The developer goes straight into using the toolkit experimentally. Initially they will lose a few days (2-4) playing around, getting familiar with the tool and the concepts used in DIADEM transactions. In time this maybe aided by online tutorial material or forums where other developers discuss the transaction concept. Given the variable level of competence and limited exposure to DIADEM transaction development it is assumed that they continue to learn on the job. The scenarios allow about 5 days each for first two or three transactions but assume that as the task gathers momentum and the rest can be developed more quickly.

- Third it is assumed that instead of developing definitions from scratch a less experienced developer takes existing definitions from a library or catalogue and adapts them. This could be a public library of common transaction definitions or the set of transaction definitions for a generic package. Customisation in this way is assumed to be much quicker and that an average of three definitions a day can be customised.

All of the analyses above assume that text to speech is being used for creating sound files. Some organisations will opt for a recorded voice rather than speech synthesis because of the more acceptable experience it generates. During the DIADEM trials Sheffield made semi-professional recordings for a single transaction and it took about a day preparing for each trial. With a batch of related transactions many texts would be the same so it is assumed that a significant batch of transactions would require an average of ½ day each.

Another thing that could affect translation times in a large organisation is the possibility that they already use form generation tools such as the ones marketed by MORE. During the project MORE experimented with modifying their tool to export DIADEM transaction specifications. MORE only required 10 days to make the modification to their XForm tool but with the need for thorough testing and because they are not as familiar with the XML used by DIADEM others will take longer. Based on this experiment the estimated time for an organisation to repeat the exercise is 30 days for writing and testing the export routines. The resultant files will still need further tailoring to make use of DIADEM's capabilities to the full effect, but using the export capability is expected to at least halve the time to produce each transaction definition.

B.2 Other technical development tasks

All applications will need some minor modification of the static content to make links to the DIADEM service available as an alternative to the current forms. When this was done to produce a mock-up of a single Sheffield web page linked to DIADEM the time required was only an hour or so. Any real application will need links added in several places. Based on CSI's experience setting up a shopping application with DIADEM even a small application would need at least a couple days work to add and test the links thoroughly.

With larger applications more time is needed but big sites would have some form of content management system and that makes it unnecessary to modify individual HTML pages one by one. Discussion with Sheffield's web management staff suggests an assumption that in these cases modification and testing is unlikely to exceed 10 days.

This could be that adding the links is the only task needed to link the DIADEM transactions into an application. This is because, like XForms, DIADEM can return data using HTTP-PUT transactions and mimic an existing HTML forms interface. However, this will not always be the case and use of DIADEM may give rise to the need for other modifications in application software so that it can supply data to the application or interact with it during the transaction. The things that may need to be done are:

- Modifying the core application interface so that user authentication (login data) can be provided concurrently with the transaction data.
- Developing web services interfaces for DIADEM to interact with an application – for example by sending a date and destination to retrieve the relevant timetable.
- Setting up the necessary interface components and links for accessing banking and credit card payment services.

The first two of these are standard application development tasks, which are highly dependent on the language and software development environment; the existing architecture and quality of coding; and the nature of the application itself. Only a rough estimate is possible but based on the partners own previous experience developing web service interfaces an allowance of 5 days effort per interface or service seems to be reasonable.

During the project the most difficult adaptation to make was identified as one that needed payment service connections. However, many application providers need payment services and there are relatively few widely used services. It is assumed that the DIADEM organisation itself will engage with payment service providers and agree transactions and procedures with the various payment systems. All an individual application provider will need to do is use the library transaction definitions and integrate the agreed procedure into their application. It is assumed that this will required about 5 days like the other tasks.

B.3 Operational considerations

Once the adaptation work is complete organisations just have to rollout and operate the new website. Some rollouts might be done in a few minutes but they should be done with some organisation and care. Based on CSI and Sheffield's operational experience an allowance 3 to 5 days effort depending upon the size and formality of the organisation is included for organising the rollout.

Once it has been rolled out, the operational cost is expected to be minimal. The transaction definitions and supporting files are static content that the DIADEM service will retrieve from the application provider web server with standard HTTP requests. During the DIADEM trials a single form required about 13.8 Mbytes of storage. However, most of this was the recorded sound files, some of which would be shared between several transactions.

Local authorities are expected to be typical large users of DIADEM and the detail in the scenario above reflects the operational demand Sheffield have anticipated. Even with a significant traffic load the direct operating costs are expected to be a very small fraction about 0.3% of the ICT budget. There is no reason to expect operational costs to be a major factor in other types of application.

B.4 Training and familiarisation

Application providers need staff training both for transaction (form) developers and help desk staff. Dealing with help desk staff training will be a relatively short internal exercise but tie up several trainees at once. How much is at the discretion of the application provider but Sheffield's operational staff have confirmed that an allowance of 10 days staff effort appears to be reasonable.

The DIADEM organisation itself will provide support for developer training. Based on MORE's experience it is assumed that training for 3 developers will tie them up on a two to three day course and cost the application provider 10 days staff time.