March 29, 2003

Evaluation of the Competence Centre for User-Oriented Design, CID at the Royal Institute of Technology, KTH, Stockholm

1. Preface, Methodology, and Acknowledgement

On the Friday, March 28, the technical staff of the CID Competence Centre briefed two of us, the scientific experts Professor Patrizia Marti and Professor Tom Rodden, on the four established scientific programmes on Connected Communities, Interactive Learning Environments, Interaction Forms and User Oriented Design. The presentations were delivered by a combination of senior scientists, academic staff and PhD students. These presentations were complemented by a series of demonstrations.

On the Morning of Saturday March 29th, we were briefed on these same areas and the surrounding context of the CID Centre. The presentations given complemented those of Friday, with the addition of presentations from the Chairman of the Board and a selection of the industrial partners who described their relationship to CID.

We would like to thank the CID Director, Professor Yngve Sundblad, and all of the industry representatives, scientists and students involved with CID for the presentations describing the Centre and its scientific programmes. We appreciated the openness and warmth of the members of CID, particularly their willingness to answer questions, provide demonstrations and engage in debates and discussions. Our thanks also go to VINNOVA for inviting us, and to Barbro Atlestam and Staffan Hjorth for assistance in all aspects of the review.

2. Technical and Scientific Outcomes

The last three years have seen significant progress in the scientific research programme of CID. We have seen a significant increasing in external publications

- an increase from 1 to 7 journal publications including a special issue dedicated to CID;
- an increase from 0 to 6 book chapters;
- an increase from 16 to 35 papers at international conferences.

CID has also graduated 8 PhD-students (5 doctors and 3 licentiates), which is nearly double the target suggested by the review team three years ago. In terms of the top-level measures it is clear that CID is operating as a leading international research centre. The research programme for CID is managed in terms of four broad themes

- Connected Communities
- Interactive Learning Environments
- Interaction Forms
- User Oriented Design.

Each of these different areas has a dedicated leader and is managed fairly autonomously within the broad structure of CID. This approach to management has been very successful in structuring and driving the research. This has greatly reduced the demands on the Director of CID and represents a significant response to the recommendation from the last review to lighten the load on the Director. This section of the report will consider each of these areas in turn.

Connected Communities

The Connected Communities programme is led by Sören Lenman and involves 11 researchers from a broad range of backgrounds. The work has engaged strongly with a number of CID partners over the last few years. The current main partners are Telia and Vattenfall/SwedPower. The work is clustered around three main themes; new form of media, digital environments and video spaces. The work has a number of significant projects in all these areas.

One of the notable aspects of this work that differentiates it from many other labs is the commitment to deployment of the media technologies in locations where they will be exposed to the general public. For example, in the case of digital communities, the work at CID has created direct and significant connections with museums and centres of culture. This link with the Swedish citizens and engagement with the public cultural organizations provides a significant influence of the work. The work in virtual reality, VR, linked with Vattenfall/SwedPower has also exploited VR as a training resource. It is worth commenting that CID has demonstrated considerably more success in the deployment and use of VR environments than many other labs.

Work at CID has been responsible in partnership with Vattenfall/SwedPower for broadening their consideration of usability across Vattenfall/SwedPower. With the help of CID they have established a usability network within the organization, which has been used to develop a range of projects within Vattenfall/SwedPower in partnership with CID. Two main areas of work have been establishing links using the results from the video space project and exploiting the work of VR and visualization projects. This is reflected in the way in which the work on virtual inspection of plants has considered techniques to address a broad set of senses to complement the work of others who consider the modelling of the control system and the sensing of the status of plants.

We recommend that the researchers consider a closer coupling between their explorations of the broader context with the work on monitor in this class of control system. This work may benefit from the exploration of semantic web technologies within the learning environments.

The work on the video café provides a significant example of how adventurous research can be refined and developed and moved from a research lab to the practical world of real world users. Over six years this work has changed its form from an installation at coffee tables at Ericsson and CID to an everyday tool for the police in the archipelago. This migration would not have taken place without the demonstration of internationally high quality research in real world settings or the existence of CID as a Competence Centre linking with users.

Underpinning the technical elements of this work is a set of studies of the community to be supported from an anthropological perspective. CID is one of a few labs that exploit studies of the situated nature of work to inform design. This work connects with leading international researchers and extends many of the key methods being suggested by these researchers. It is clear that the studies associated with the archipelago will lead to international publications particularly given the challenges of developing embedded technologies for this domain and the issues in studying three different sites and designing and installing a system to link these sites.

CID has also been involved in the development of novel museum exhibitions. This work represents engagement with a significant market sector given the worldwide growth in exhibitions and exploratoriums. The work on the space adventure provides a major demonstration of the use of VR within exhibition spaces that link a number of museums and provides an on-line experience. The work on the history lab shows the use of VR technologies to allow student participation in the development of a representation of historic Stockholm.

The work on the well of inventions provided an exhibit to support museum learning. The exhibition provided "seed" material to start a collaborative dialogue to allow users to construct their own pedagogy. The resultant exhibition brings together a technically challenging set of technologies in an interesting and novel manner. The museum is sufficiently happy that they wish to buy the exhibit as it stands and have already started to use the methodology supporting this work. We would like to commend the team for developing the technology to a sufficient point where it is robust enough to be used by the general public.

We recommend the team associated with the well of invention to engage directly with teachers and place more emphasis on the pedagogical objectives of this work.

Underpinning this work is a novel methodological approach based on the notion of a living exhibition, which is also been explored as part of the Shape project, which is an EU project coordinated by CID and involving four institutions. The work focuses on the way in which a number of technologies can be assembled in public spaces. This project has demonstrated a number of different public events that have led to publications in international conference proceedings. Novel devices have also been developed, such as the tone table, which has led to novel interaction techniques. The analysis has suggested a much richer picture of continuous interaction with a surface and has explored novel sound and projection work suitable for public places. This work significantly advances the state of the art in understanding interaction and in the museum world.

This work exploits advanced graphics techniques with the development of supporting libraries for this class of application. The researchers do not see themselves developing novel algorithms but rather exploiting graphics in novel applications. We would encourage this broad strategy.

The work seems to focus on interaction rather than the museum content and narrative structures surrounding explaining of exhibits. We would encourage the team to balance the current focus on interaction design with a consideration of content design. This

emphasis on content would support the general living character of the exhibits by ensuring that they are sensitive to the content of the museum.

Interactive Learning Environments

Work on interactive learning environments is the smallest research grouping. It is led by Ambjörn Naeve and involves 4 researchers. The work focuses on exploring new kinds of e-learning architectures. This work involves a wide range of collaborative projects looking at developing new forms of learning environments. A considerable amount of this work has taken place in the context of the semantic web. The aim has been to focus on the development of very open tools. They constitute important links with leading educational players in Sweden and the projects have a significant impact in the international web community. CID is actively involved in the international standards bodies that will help form the future digital infrastructure.

The work on standards is complemented by publications in major forums for publishing web technologies. These include the World Wide Web conference and web based learning environments. The work is certainly internationally leading and shows significant contribution to web based technologies and e-learning. This work is based on the construction of a range of compelling demonstrations of interactive learning environments. These demonstrations are all the more compelling because they link with the real world education and learning. For example, the work on Edutella has been deployed across many high schools in Sweden.

The work in CID is in contrast to many existing approaches, which focus on information and content delivery rather than the construction of knowledge. The work in learning environments focuses on tools to allow the construction of knowledge structures and the decentralization and recomposition of content. This approach is likely to be much more powerful in the longer term than current approaches. A significant focus for this work will be on mathematical subjects although these tools have broader application.

A significant strength of this work is that it demonstrates the work through software. Considerable interest has been shown from a number of different organizations in putting these tools to work. This includes links with other researchers through future EU FP6 bids and educational television broadcasters who are exploring the use of their tools. The grouping is also considering the development of training courses for companies surrounding their approach.

We recommend that the information learning environments grouping focus on ensuring take and use of the tools and monitoring their results rather than further development. Ideally, this should be in partnership with CID partners. This may be done in partnership with other CID projects, for example, the work currently underway with Vattenfall/ SwedPower.

Interaction Forms

This work is the largest research grouping at CID and is led by Bo Westerlund. It involves 17 researchers with a focus on studying new forms of interaction that extend beyond keyboard and mouse. The work brings together designers and technologists to consider the design of new interrelationships between users and technologies. The work

spans a number of different user groupings including less able-bodied users. The work stresses the senses other than visual including work on sound and haptic interfaces.

The work in this area demonstrates considerable imagination in the use of technologies to interact with users. What distinguishes the work at CID from many others is finding ways to put these novel arrangements to practical use. For example, the work on collaboration between blind and sighted users exploits technology to provide an audio space that allows both to collaborate. Similarly, the work on interLiving considers how embedded technologies can be used to support families with a particular emphasis on communication between generations. The commitment to connection with the families involved is to be commended and demonstrates one of the leading examples of this form of work in the world. The links with the US (via University of Maryland) and France provide strong evidence of the international standing of this research work.

The researchers in this theme should be complemented for the combination of highly innovative interfaces with practical everyday purposes. While other research institutions have sought to exploit more playful environments to demonstrate these concepts the commitment to practical uses of the technology in real world settings offers a significant contribution. CID is probably one of the leading sites in the world in terms of moving these new forms of interface from being strange to becoming everyday artefacts.

The long-term partnership with families in interLiving is also indicative of the partnerships CID has established between user organizations and researchers. This duration of the various partnerships with users and the maturity of the link between researchers and users is one that many research labs are envious of and one that is exploited well within CID. We would commend this partnership and encourage CID to maintain the strong link between innovation in terms of the interface and the needs of real users communities.

We recommend that the grouping exploit the unique longitudinal nature of the interLiving work to ensure traceability of the studies with the eventual designs. They are placed to be one of the very few in the world who could do this.

The link with the Swedish disabilities organizations is to be commended. It is clear from the presentation from Stig Becker that a healthy and strong relationship exists between the Handicap Institute and CID. This work focuses on considering design for all in order to achieve a more inclusive involvement of non-sighted users. The work in association with CID has already led to benefits through sharing information and learning from CID including learning different methods of evaluation and user involvement in the development process.

In addition the Handicap Institute has been able to convey the needs of disabled user needs. A particular useful part of the connection has been the ability to look as well as more fundamental issues involving the use of sound and soundscapes, which will show benefit in the longer term. The Handicap Institute wishes to stimulate this work and to encourage users to focus on this. Stig Becker stressed that although the results appeared at present to be rather crude they offered a significant advance and he could envisage their widespread use in five years time.

The work currently follows an experimental user driven process of exploration where designers and developers work in close partnership with both sighted and non-sighted users. This has led to an exploration of 2D soundscapes as a means of understanding interaction and collaboration between sighted and non-sighted users. This work may benefit from the involvement of researchers from a psychoacoustic and psychometric background.

We recommend that researchers explore links with people from a psychoacoustic and psychometric background to complement the current set of competencies.

User Oriented Design

This area of the research programme is directed by Ann Lantz and includes seven researchers drawn from a range of backgrounds. The work focuses on engaging with real world user communities and involving these in the design of technology. This link has taken the form of evaluation and certification procedures that are strongly linked with CIDs partners and Swedish industry in general.

The work in formal meetings at a distance explores the evaluation of novel technology arrangements. This work has observed a range of technologies in real world settings and considered how these can be analyzed in terms of media genres. This approach holds considerable promise and may well influence the future design of this infrastructure by broadening existing considerations on the development of this technology. However, the work is still at an early stage. The users have been selected from the CID partners, thus representing a significant point of influence from CID towards best practice in Swedish industry. This form of link and its influence should not be underestimated and CID is to be commended for establishing such a strong link.

The work on Users Award is an innovative and exiting approach to improving people's awareness of the importance of users in IT. The project seeks to develop a certification procedure for IT that is influenced by the needs and demands of users. This form of certification procedure is likely to have a major influence in the use of IT in Sweden. It is a difficult task and CID is to be commended in engaging with such a strong national and international process.

As a starting point the project has exploited the use of a users prize, which invites people at workplaces to nominate their favourite workplace systems. This project seeks to readily understand the ways in which technology finds a place in Swedish workplaces and to certify that IT systems meet particular criteria. In outlining these criteria and a process through which suppliers can be certified means that this work has the potential to strongly influence the broader Swedish policy in IT and the workplace. It has reached the stage where providers acknowledge the importance of certification and are currently willing to pay for user certification. This certification process represents an important point of real influence for the work of CID across the industrial community.

The project also offers one example of a movement from work conceived at CID through joint development to product. It has led to the development of a company to drive this work and may have a significant and major impact in terms of the international Quality

management including processes such as ISO 9000, which currently has little evidence of user certification and would benefit from the work of CID. The project has the potential over the coming years to place Sweden as a leading figure in user standardization. Not only does it demonstrate the success of CID. It also raises a challenging future agenda to maximize the impact of very high quality research.

We recommend that CID actively target ISO for dissemination of the results in user certification. We also recommend that those involved in user certification obtain data from ISO 9000 on the costs involved in certification and highlight the benefits to be gained from the suggested low cost approach.

It is worth noting that the work on user-oriented design seems to be different from the other three areas of activity (connected community, interactive learning environments and interactive forms). It appears that user oriented design permeates the work of this area while the three different areas have a much stronger thematic focus. While diagrams in the introduction reflect this distinction, CID may wish to explore the difference between these different groupings and consider whether they need to be managed in different ways.

Concluding remarks

It is clear that CID provides an environment that fosters multidisciplinary research and thinking. This is evident not only in the quality of individual research projects but also in the level of energy in the Centre. Few places bring together the disciplines evident at CID; even fewer do it with its level of enthusiasm and success demonstrated. It is clear that this environment has been constructed to encourage those involved with CID to undertake research in new areas and to think in new ways. CID should see itself as an equal to most international labs including those at MIT, Georgia Tech, PARC.

CID has developed significant and substantial links with both industry and user groups. These lie at the heart of much of the research and are a key strength of the Centre. It is clear that CID has focused on pursuing a strategy of a small number of in-depth research areas, to complement broader connections with a larger number of organizations. They have also evolved these groupings in order to keep pace with changes in international research.

The supportive nature of the overall environment extends to the education of a new generation of researchers who understand the combination of disciplines. CID has graduated 5 PhDs and 3 licentiates since the last review and is to be commended for this. We were impressed with the commitment and motivation of the postgraduate students who presented their work in a confident manner that demonstrated significant engagement with the core research of the Centre. CID provides an environment to allow these students to develop into the next generation of independent, first-class researchers who will make a significant contribution to the Swedish research community.

3. Industrial Benefits. Impact on Industrial Partners.

Industrial Interaction and Involvement in Centre Activities

CID has made further progress towards becoming an efficient platform for close and productive industry-university collaboration and technology transfer. Given the nature of the technical area and competence profile of this particular Centre, the Centre leadership has correctly sought and succeeded in involving actively in the Centre programmes outside constituencies and organizations representing organized bodies of user groups in addition to industry partners. Premier examples of such involvement are the Swedish Handicap Institute, workers associations LO and TCO, the Swedish Educational Broadcasting Company, the Stockholm County Police. Thus, much needed interactions between academic researchers, industry engineers and large groups of users, have a rather unique opportunity of being systematically pursued and utilized. We were very positively impressed by this arrangement, which gives CID a rather unique capability.

There are now seventeen industry and user partners in CID. The strong involvement of these partners, eleven of which stayed on from stage 2, clearly demonstrates the needed long term commitment of the partners and the values represented in their participation in CID. Sustaining this number of partners through difficult economic times, which have hit particularly hard the IT sector, is impressive. The mix of companies involved, five large, four small, is appropriate for this technical area. The cash contributions of the partners amounts to 12 % of the total cash budget. This is recognized by the Centre management as low and efforts are undertaken to improve the contribution level.

The combination of industry partners, government organizations and user associations, makes CID a unique platform for pursuing user-oriented design of IT systems. All representatives of participating industry and other organizations were enthusiastic about their involvement and the benefits derived from interactions and collaborations made possible through CID. There were several explicit examples presented where academic researchers, industry, user organizations were closely collaborating. These collaborations have resulted in better IT designs, the conception and introduction of new technologies and in some cases have dramatically changed understanding of capabilities in human computer interactions. This model of engagement has helped CID become a leading Centre in user oriented IT design with significant impact on the state of the art.

Following the previous international evaluation team recommendations in March 2000 CID has improved substantially the methods of disseminating information to industry and outside constituencies, as well as to society at large. In order to maintain their links with industry and other users CID holds 30-35 seminars per year (with approximate attendance 25 persons per seminar) and 2-3 open houses per year. These seminars and open houses help build an in depth engagement with industry that allows industry to communicate research questions to academic researchers and for CID to shape best practice. Better communications with the general community have been achieved through public exhibitions, newspaper articles, review articles, TV and radio interviews, and prototype demonstrations.

The benefits of user involvement throughout the design of an IT system are shared among the partners of CID. Still the majority of ideas and directions for research is generated by the academic researchers, although good progress towards a more balanced situation has been achieved. This imbalance is partly due to the nature of the technical area and partly due to the fact that appreciation and popularization of these technologies to industry and user organizations is a recent and slowly progressing process. Nevertheless, we believe that the development of a strategic planning process at CID, to be used for relative evaluation of ideas, proposals, and projects is very much needed. It will help in developing much needed cross connections between technical areas and projects and at the same time it will improve the balance of idea generation between academic and non-academic researchers. It is highly recommended that such a process be established.

The establishment of the Programme Council in addition to the Board is a good idea. The Council meets 3-4 times per year and helps steer and guide the overall research programme. The goal is for the Programme Council to provide an open forum and link between academic researchers and industry personnel. In addition this body is to provide means for maintaining existing partners and seeking new ones. We were not given any details on processes or methods established by the Council towards achieving its stated goals.

A significant proportion of CID's research portfolio is funded through the EU 5th Framework Programme. In fact, CID was influential in establishing many of these programmes. It is worth highlighting that the objective of these projects is to develop pre-competitive technologies rather than seek to develop products for direct exploitation. CID has blended these projects with other projects that are more directly influenced by industry needs and commercialization opportunities. The result is a good mix, which advances the research agenda of CID while simultaneously providing opportunities for commercialization of results closer to market needs.

Implementation of Results: Technology Transfer, Commercialization, Success Stories

Industry and other non-academic partners in CID principally gain knowledge and understanding of user oriented capabilities of IT and means by which users can influence these designs. Technology transfer has occurred in a broad sense through this "culture changing" process. We were impressed by the results. The unique environment at CID described earlier has resulted in some cases in rapid progression of new technologies (often unusual for the typical user) from conceptual and laboratory prototypes to systems and technologies used in practical settings and new applications. A very good example of this progression is the way in which the Cyber Café system matured from shared coffee tables via an artistic exploration with children through an in-house deployment within CID to become used by the Police within the archipelago of Stockholm County (Community at a Distance project).

The work on user certification is worth highlighting as an internationally leading example of research directly influencing industrial practice, and even leading to commercialization. This work addresses a very significant problem for IT products usability by industry. It demonstrates clearly the unique effectiveness of the CID environment in addressing such problems. It has led to the formation of a company

(UsersAward AB) to commercialize the process and the resulting products and services; this is the right mechanism for widely spreading these benefits to users. This activity is likely to become a significant endeavour over the coming years and will need to be managed appropriately. Certifications should not become CIDs core business, which should remain research.

Other examples of "success stories" regarding technology transfer and commercialization, presented during the review were: Knowledge and technology transfer to Vattenfall for their virtual inspection and visualization needs; Knowledge and technology transfer for interactive learning environments in the digital media library of the Swedish Educational Broadcasting Company.

Far better success and impact to industry and user organizations can be achieved through effective coupling of the various projects, including collaborative efforts with industry. For instance semantic web ideas could help most of the CID projects and provide mechanism for step-by-step demonstrable progress and convincing prototypes. There are several other such linkages between software engineering, database research and computer science design methods that need to be linked with the user oriented design theme of CID. It is highly recommended that mechanisms and strategies to create and encourage such linkages and cross-fertilization be established. It was agreed during the review discussions that CID is at that stage of its evolution where such links would be maximally profitable.

Finally, at some point over the next two years CID management should address the question of involving as partner(s) software development companies to aid in the commercialization of research results.

Conclusions and Recommendations

CID has sustained excellent progress towards industry-university collaboration and technology transfer. The involvement of user organizations has resulted in a unique environment for user-oriented IT systems design. The following recommendations are offered towards further improvements:

- Establish a strategic planning process to be used in defining broad goals and objectives, link projects, evaluate progress, initiate and terminate projects and define future plans.
- Develop and implement mechanisms for link between the project areas and for linking software and computer science design methods with user-oriented methodologies.

4. Present Standing of the Centre

International Ranking and Attractiveness

CID has a strong international profile in its area of expertise and has links with a number of leading international centres. It currently coordinates a number of EU projects and is

involved in coordinating the formation of an IP for the 6th framework. These links also extend to the US with a range of project activities linking with US researchers. CID has a strong research profile and a number of research visitors have been attracted to CID during its lifetime.

Members of CID have been involved in a large number of programme committees and have edited a range of international journals including a special issue of the Behaviour and Information technology journal addressing the work of CID. The outputs of CID place it as a leading international research centre in this area alongside leading European, US and broader international centres.

CID has been represented at a broad range of academic and international conferences including leading trade shows such as Comdex. This activity has significantly raised the profile of the Competence Centre and has allowed the department to demonstrate the key competences of CID.

In addition to the Centre Director, there are now several senior scientists with backgrounds not only in Computer Science and Mathematics but also in Humanistics, Education and Media. They work half to full time within CID, providing multidisciplinary scientific leadership so that each of the programme areas that define the core competences of the Centre can be considered to exceed the minimum size required for a well sustainable research group.

The Centre as a National Asset

The Centre contributes significantly to Swedish university education in computer science not only directly through courses but also in making the students aware of human centred and design aspects of computer use and interaction. Transfer of knowledge and experience to industry and other users takes place by arranging seminars and courses with lecturers from both industry and CID and by joint supervision of research projects by CID and industry personnel.

The ability of CID to engage organizations such as LO, TCO, the National Agency for Education, the Handicap Institute and the Swedish Educational Broadcasting Company not only as members but also as active participants in projects shows that CID through the application of its front-line research plays an important role in the design of user-friendly IT for use in the public sector in Sweden.

Role and Impact of the Centre as a Part of the University

The establishment of CID at KTH has helped in establishing HCI as a third research educational subject and a HMI research school. This has grown to establish doctoral and licentiate projects and exams. HCI is now a specialization in several KTH educations, 25 master degrees have been completed and 10 are underway. They have provided guest lecturers and supported interdisciplinary project courses.

CID has played a significant role as part of the academic community of KTH and has helped shape the educational view of computing at KTH. In particular, CID has been

instrumental in establishing HCI and multidisciplinary aspects of computing. The contribution to the department and the university has now placed NADA favourably within the computing community.

CID involvement within the 5th framework has made a major contribution to KTH. It has also been responsible for shaping many of these initiatives and coordinates 2 projects (of the in total 4 coordinated by NADA) as part of the work on future and emerging technology.

Finally, CID provides a significant increase in profile of the department through media coverage in radio, TV and the popular press. The open houses has been a useful mechanism for raising the profile of the department while the involvement of artists and the development of a number of permanent exhibitions provides a positive contribution to the added broad profile of the department.

Conclusions and Recommendations

The core competences of CID have received extensive application in the design of user-oriented IT interfaces both in industry and in the public sector of the Swedish society. CID has played an important role in the development of education in HCI at Swedish universities. There is no doubt that CID should be regarded as at national asset and it is very important that the sustainable development of this asset should be made certain.

5. Future Prospects and Strategies

The main strategy for Stage 4 is to continue current work within the four main areas and to find long-term financing so that new graduate students can be accepted. The present ten students at CID are expected to graduate during the Stage 4.

The strong support of CID from many public organizations shows that there is currently a strong interest in Sweden in the role of design in creating innovative products for sustainable growth in general and design of IT products and services in particular. The frontline position of CID in its core competence areas, in particular interactive learning environments and user-oriented design, imply that the prospects of further successful research and implementation of results in applications for the public sector and industry should be good. CID is actively participating in the on-going debate on where future research in IT should be aiming.

In 2002 the Board of CID initiated an investigation of different alternatives for the formulation of a strategy for continuation of CID activities after the ten-year period. Several different alternatives have been considered, including extensive participation in EU research projects, funding from other national agencies than VINNOVA and a new Competence Centre focusing on user-oriented design of IT support for creating quality and better conditions in work. The fact that CID is already actively planning for continuation is encouraging and we urge CID to continue this planning very actively.

6. General Conclusions and Recommendations

CID has established an exciting research programme in User Oriented HCI-Design. It is well recognized as a resource in this area by Swedish industry. Its research is also internationally leading as is evidenced by publications and demonstrations in leading conferences and journals. It plays an active part in international summer schools and in setting future research agendas.

Since the last review CID has progressed well and addressed nearly all of the concerns raised. In order to continue the progress already demonstrated, the CID management and leadership should address the following particular challenges during the next two-year period:

- The researchers involved in working with Vattenfall/SwedPower should consider a closer coupling between their explorations of the broader context with the work on monitor in this class of control system. This work may benefit from the exploration of semantic web technologies within the learning environments.
- The information learning environments grouping should focus on ensuring take and use of the tools and monitoring their results rather than further development. Ideally, this should be in partnership with CID partners and in partnership with other CID projects, for example, the work currently underway with Vattenfall/SwedPower.
- The researchers involved in user certification should actively target ISO for dissemination of the results in user certification. In particular, they should obtain data from ISO 9000 on the costs involved in certification and highlight the benefits to be gained from their low cost approach.
- A strategic planning process should be established and used in defining not only broad goals and objectives, but also to link projects, evaluate progress, initiate and terminate projects and define future plans.
- Mechanisms should be established for development and implementation of links between the projects and for linking software and computer science design methods with user-oriented methodologies.

Stockholm, March 29, 2003

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