Managing nuclear knowledge: a governmental perspective

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Abstract: Governments and industries have different perceptions about knowledge management. Vision of a corporate is house is limited to 3–5 years, while governments have to plan for decades. The industry works in a competitive environment and has to direct R&D towards customising the existing knowledge base, while governments have to direct R&D towards search for further knowledge.

For a higher education programme to succeed, four attributes are very important. These are the linkage of the higher education programme with frontline research, providing necessary excitement to the young students, the linkage with the society, the industry and national programme, and the matching of the needs of the human resource development programme with the actual requirements.

Keywords: technology management; knowledge management; human resource development; technology transfer; linkages.

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Biographical notes: Anil Kakodkar joined the Bhabha Atomic Research Centre (BARC) in 1964, and became the Director of BARC in the year 1996 and took over as the Chairman, Atomic Energy Commission and Secretary to the Government of India, Department of Atomic Energy, in the year 2000. Throughout his career, Kakodkar has been associated with the research and development work related to nuclear reactors. He played a key role in design and construction of Dhruva reactor, the 100 MW high flux reactor. Over several decades, Kakodkar has made significant contributions to indigenous development of a large number of critical systems of Indian Pressurized Heavy Water Reactors, to safety related research and has piloted several new state-of-art technologies for reactor systems. Kakodkar continues to lead the team engaged in the design of the Advanced Heavy Water Reactor.

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I have decided to adopt the same title that was given to me by the organisers, although whatever I am going to speak are essentially my individual views. I think it is important that we do recognise the differences in the perspectives between an industry, a nuclear power industry or industry dealing with nuclear technology, and that of a Government. We have been hearing since morning several presentations, and we are in an ironical situation where, while on the one hand we do perceive that now there is a need for nuclear power, not only in developing countries, but also a renaissance in developed and industrialised countries, on the other hand, there is the question of how soon the markets will start getting into this business on a scale where this question of Management of Nuclear Knowledge [1].

Knowledge gets solved by itself. Seen from a broader perspective – and I am talking about Management of Nuclear Knowledge, not just Management of Nuclear Technology, although the individual industries or for that matter, individual countries, may have been right in whatever actions they have taken but collectively it seems to me that we have failed somewhere and that is why we are here in the present situation and this has happened because of what I would call the perceptional constraints which have eluded solutions to this very important problem. IAEA being a body, which is represented by governments, I think it is important that we make attempts to clarify, among ourselves, these perceptional constraints and see if collectively we can make some progress forward.

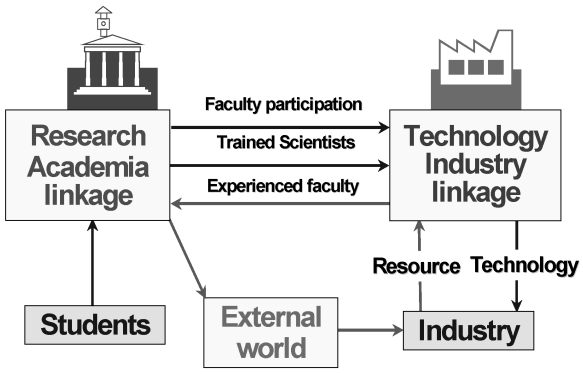
By definition, there would be differences between the governments and the industries. The first is the time horizon. Industries, by necessity, are driven by the business motives, so even if you say that a corporate house has a long-term vision, that long term by their definition would be three years, five years or something of that sort. When we talk about governments, governments are more driven by the need to act in accordance with the welfare requirements and obviously they have to have much longer perception and there we may even talk about a few decades or longer, and I think it is important to differentiate between the actions or the motivations of the governments and the industry. Another difference that we must recognise is related to the scope of R&D that is supported. Industry works in a competitive environment and so, by and large, the industry R&D is more directed towards customising the existing knowledge base, the existing R&D base, to a particular product or goods or services whereas the government supported R&D is inherently more generic in nature, and combined with the long-term perspective that it must have, it must address the core issue of development. We should talk not only in terms of the technology development, but also in terms of the impact of that technology on society, and should that lead to some issues, then, I think it would be necessary to take up alternative or additional technology development to address such issues. It is important that the basic issue of Management of Knowledge as far as the government perspective is concerned must drive all branches of knowledge, and the driving force has to be the need to search for further knowledge over and above what is already existing with respect to what I call the technology–society interface, quite distinct from the business and market interface that would drive the R&D in an industry. Many times, the short-term industry perspective – and sometimes, we even end up with governments getting into that type of perspective, which is driven by business motives – in fact, retards the pursuit of broad-based research, which leads to a feeling of several open-ended issues remaining unattended. In my view, this is one of the challenges that all of us engaged in nuclear technology development must address. I also feel that somewhere along the line, collectively, we have failed in this area and that perhaps is one of the causes why the market for nuclear power has not grown as it was expected in the

early stages. We all know that the Agency has had the so-called small and medium nuclear power reactor programme for quite sometime. We have not made much progress. I think we must examine why the market has not grown in spite of the fact that everybody knowledgeable in nuclear power is convinced that nuclear power is a perfect answer for sustainable development. There is clearly a need to drive knowledge based holistic solutions to emerge that lead to technological answers to the entire gamut of technology–society interface. In fact, today we are in a very awkward situation of debates on Sustainable Development and climate change taking place without a proper appreciation of nuclear power technology, the most viable solution to sustainable development with its minimum carbon dioxide emissions.

Let me now turn to higher education. I would like to highlight four most important attributes of higher education. Any higher education programme must be in an active frontline research environment. It should provide the necessary excitement for the young students and researchers in the respective field of study, in our context, say, in nuclear technology. It must have an ingredient to fight obsolescence. Many times one hears the comment that a fully developed technology is available and all you need to do is to just make use of it. I think the problem starts there. There must be an ongoing effort to search for improvements. The linkage with society, the industry and the national programme must be visible to the students right at the stage of their higher education. They must clearly understand the issues that are involved and the challenges that need resolution, so that they can work forward on the resolution of those challenges that provide, in my view, a degree of motivation, which will carry them forward. Finally, there is the question of matching of the needs for human resource with the actual requirement. We need to distinguish Knowledge Transfer from Technology Transfer, which has a much stronger commercial connotation. Knowledge, on the other hand, is enhanced by sharing as has been brought out by several earlier speakers. We should however, add a qualification. Knowledge is enhanced by sharing with worthy scholars who can sustain the process and also with those who can translate it to finding new solutions of societal interests. In the context of nuclear power, there is, as we are all aware, considerable scope to pursue several new areas of higher education and learning which can address the currently perceived barriers in terms of sustainability, long-term waste management issues, issues of economics, issues of proliferation concerns and issues of safety. Supporting research and education in these areas would not only facilitate emerging interests but would also enable professionals to be available to take care of ongoing activities which have a life cycle much longer than an individual's professional career as a part of ensuring a good synergistic linkage between academic programme, national research programme and industry, I think a model something similar to what is depicted in Figure 1 would be very useful. As I said earlier, there must be a good research-academy linkage. There should also be a good technology–industry linkage with society kept in the prime focus. In such a scenario, students entering a university benefit from research, which is real life research. A comment was made earlier about adverse consequences of hypothetical research projects. I think that this is very true. It is absolutely important that students work on real life projects which are of interest to the industry, which are of interest to the society and that can happen only through a very good linkage between the industry and the academia and that also helps to bring in the industry experts into teaching and the academic faculty to look at the problems of industry and the society. In the process, industry benefits from the new insights while providing inputs to the university research. I know this is nothing new and this is

something, which is being practiced in many good-quality institutions. But I am afraid, there are several other examples where this is far from reality. I think that you need to send a message across that while one could come up with several alternative models, the basic theme of interaction among different stakeholders should be an inherent part of the knowledge generation process. Quality of education is as important as its contents. Apart from up-to-date knowledge, there must be a programme of inculcating relevant skills. Even more important are the values that get inculcated among the students and, of course, a good awareness of whatever is happening in society, industry, national processes, or for that matter, even international processes, is very important. A simple test of the values is this question: does the gaining of knowledge make an individual modest or does it make an individual arrogant? Do we make an individual sensitive to his surroundings or do we make the individual solely devoted to search for self-interest? Now, these are all very standard manifestations of human behaviour, but if you have to make good sense of the technology for the larger benefit of the society, I think these quality parameters are of utmost importance. Let me now turn to the issue of sustainability. We hear about several issues connected with nuclear technology. But I think the broader issue is quite generic. In the morning an example was given about agriculture.

Figure 1 Academia, research, industry linkages



Thanks to the Green Revolution, food shortages is a thing of past in a number of countries, including India. India is now a food-surplus country. But there are issues about excessive use of fertilisers, there are issues about pesticide residues, they are all sustainability issues, just as availability of food is a sustainability issue. So, one can say that new issues could surface as technologies are deployed to solve the problems of humankind. In the case of thermal power, we now talk about the green-house gas problem, the ash-dump problem; I think what is required is a holistic view. And if we run away from technology simply because there are some problems, I think we are running away from the development process itself, and that I am sure, as everybody would agree, we can ill afford. We have to find holistic solutions, and I again put it to you that such solutions can be found only by constantly emerging technology and not by its regulation. Regulation is necessary to minimise any adverse impact to an acceptable level, but the basic solution can only come through technology. Thus, sustainability of a technology development process is the route, and knowledge is the key to sustainable development. I think this is the core issue for all of us.

This is the issue that those bothered about Knowledge Management should address. It requires holistic thinking and not segmental thinking. Coming back to Nuclear Knowledge, we have definitely seen a very rapid progress in terms of deployment of nuclear technology, but what about the sustained technology growth? I think somewhere along the line it has been throttled and that is part of the problem. The continuity necessary in knowledge building process has, to an extent, been disrupted. It is in this context that I think a programme like INPRO, which is being actively piloted in the IAEA, and similar other programmes elsewhere, are extremely important. You may not get an innovative reactor tomorrow, but I think it is an important exercise in Knowledge Management. Similarly, the Agency has a huge database in the form of INIS. This is a tremendous database as far as nuclear knowledge is concerned, and I think we have to address the issue of its use for the larger good.

Finally, let me come to the Indian situation. The programme in India is being implemented by the Department of Atomic Energy, an organisation with very diverse set ups under a single umbrella. We have R&D institutions. We have industrial organisations including the Nuclear Power Corporation, which is a utility. We also have a large number of institutions dedicated to basic research. They all work with their own respective mandates. Some work as technology development institutions, some work purely as research institutions and some work in the market place, but they are all internally very strongly linked with each other. We have a common human resource development programme and I think that the interactive linkages between different institutions have made a very large difference in terms of the programme implementation in India. We are witnessing a rapid growth with eight reactors simultaneously under construction. We have also identified implementation of all the steps that are required for the second stage of the programme comprising of Fast Breeder Reactors. A detailed road map for the thorium utilisation stage, the ultimate goal of our long-term power programme, has also been identified. Professionals within the organisation as well as the student community can look forward to meaningful and effective contribution to national development process through participation in this programme.

In specific terms, the human resource development programme in India has many dimensions. We follow the principle of 'Hire and Train'. The Training School of the Bhabha Atomic Research Centre is an institution running for more than 40 years and it has provided practically the entire scientific and engineering workforce at a professional level. It has now been diversified both in terms of different geographical locations within the country as well as looking at inputs at different levels, the graduate, post-graduate and doctoral levels. We have also linked up with the Indian Institutes of Technology in what we call the Department of Atomic Energy Graduate Fellowship Programme. It is not only a human resource programme, but is also an effective R&D programme. The human resource gets trained in the research projects that are a part of the programme. There are also programmes at several other levels as well as in several other areas such as medical physics, radiological safety, nuclear medicine, radiography and so on. And that brings me to the final point that I wish to make. This relates to what I call the inter-institution synergy. I think it is also very important in the context of the framework, which I had described earlier. I talked about our internal linkages, but we are also linked with several external institutions. We are linked with industrial units, so that is our industry interface. We are linked with the University system, as I mentioned earlier, and we are also linked with other national laboratories, and each of these linkages have their own set of objectives and the framework, and on the one hand, they contribute to the

research–education interface, and on the other to research–technology interface. Direct technology transfer is also important, and as I said earlier, it is important to properly recognise the knowledge transfer processes, the technology transfer processes and the difference between the two. Technology should never be allowed to remain static. If we allow it to be so and curtail knowledge management processes, there will always remain unresolved residual problems. While the level of deployment is a matter of market forces, knowledge evolution should be continuous. We have seen this in several technology cases. While markets would pay to the extent of its needs, the balance, necessary for continuity of knowledge, has to be catered to by the governments and that is where, I think, sustaining the research centres as knowledge centres is important. Knowledge based solutions, if appropriate to current needs – and that should be the basis of any education programme – will always find takers because society needs them. If we work our human resource development programme in that manner, then there is no question of students not seeing the growth, not seeing the opportunities and that in itself would sustain the continuity of knowledge, or for that matter, the interests of young people. I think that the IAEA, as a collective of governments, would do well in sending an appropriate message back to the governments so that we address not only the issues of nuclear energy, but also address the broader issue of technology management as a whole. Fortunately, there appears to be a renaissance in case of nuclear power.

References

1 Keynote presentation made at the *Meeting of Senior Officials on Managing Nuclear Knowledge at the International Atomic Energy Agency* (2002) Vienna, 17–19 June, 2002.