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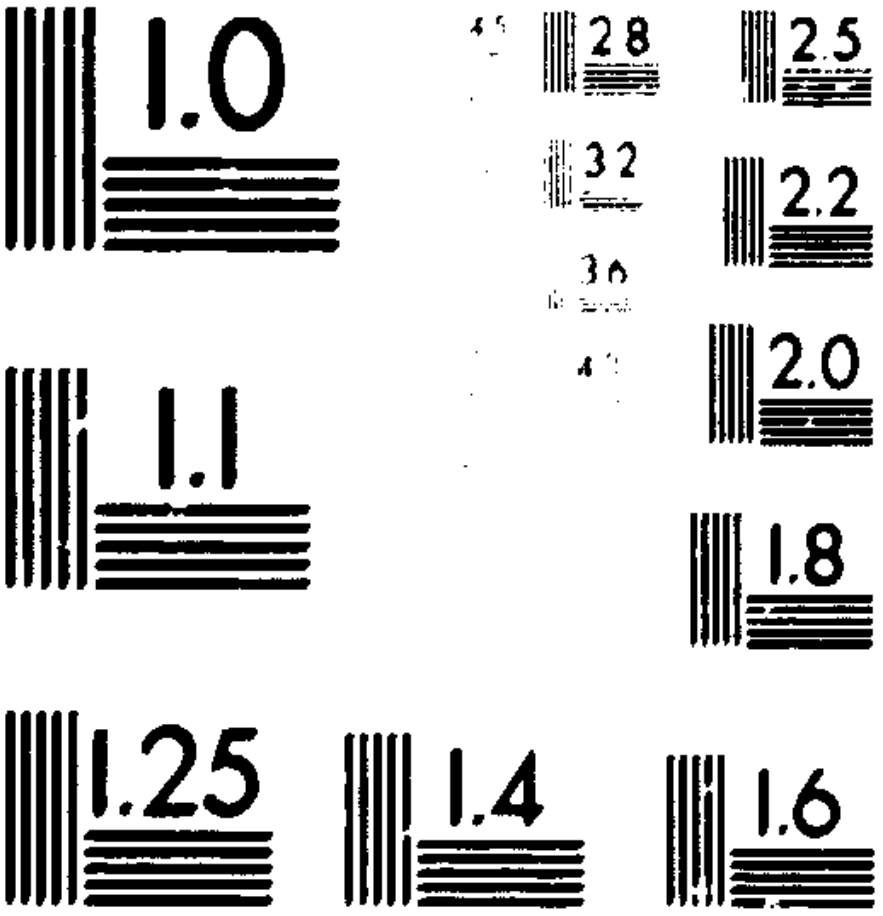

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INNOVATION MANAGEMENT IN DEVELOPING COUNTRIES

Applications from the IIASA Case Study on Innovation Management*

by

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This document is addressed to the implications for developing countries of the Innovation Management Case Study conducted by the International Institute for Applied Systems Analysis (IIASA).[1] It focuses on some general considerations concerning the problem of industrial innovation in the developing countries, then on some specific issues and findings arising from the IIASA Study which are relevant to this area, and finally on a summary of the IIASA Study results as an appendix.

I) Industrial Innovation for Developing Countries

Industrialization in the developing world is likely to have two distinct thrusts, often sequential but at least at times concurrent. The first is that of industrial development aimed at import substitution; the second is industrialization focused on manufacture of products for export, with utility and quality competitive on world markets. Management strategies aimed at stimulating innovation and creativity will have some distinctive characteristics in these two cases, and it will be important in the following to keep the differences in mind.

There is an exciting opportunity for developing countries as they move through these changes. It is clear from the

IIASA study that management thinking in general, with innovation-oriented management being no exception, has gone through a series of distinct phases for the major developed countries.[2] These phases have sometimes included painful learning processes, at other times a set of unique and instructive experiments with gradually unfolding results. At least in some cases these experimental processes have had the effect of destroying myths which tended to dominate conventional wisdom and handicap accomplishment of goals. The spectrum of experience of the IIASA countries in the relatively recent post-war era displays almost all of these phases and many experimental approaches.

The recent IIASA [3] synthesis of this data and experimental results provides the opportunity referred to: it offers developing countries the choice, after examining the historical record and patterns of results from various approaches, of foregoing or shortening some of the most painful or non-productive phases of the evolution of management thinking in industrialization. Instead, it gives them the opportunity to move immediately into a present of those innovation management skills which have proven in actual application to be effective in a wide variety of settings. The value of the opportunity of jumping over years of sub-optimal management approaches is analogous to that experienced by developing countries in communication technology. Instead of plodding through the era of wires and cables, satellite technology has helped move many countries directly into

much more advanced systems, with great investment savings. The potential of applying modern management techniques is similar.

Of course, there is some learning which cannot be transferred without experiencing it, and some which is so unique to each national setting that it cannot be easily applied cross-culturally. However, the IIASA study has indicated that even within the IIASA group of industrialized countries there has been sound evidence that past learning has been integrable into new national settings, with the result of achieving leaps of sophistication that would otherwise have had to come through a series of costly, painful, and time-consuming sequential steps. The U.S. and Western European countries show the classic patterns of market economy industrialization going from cottage to factory organization and now to the so-called post-industrial era, with management patterns changing dramatically through these phases. The Soviet Union and several of the East European countries show variations in the pattern of planned economies moving first through rapid industrialization via strong central planning aimed at matching production to pent-up consumer needs, and then into more decentralized systems aimed at quality, new products and international trade. Bulgaria, having moved through almost the entire cycle in the short time since World War II, provides a particularly striking example of how this process can be truncated by drawing effectively on foreign experience adapted to a particular national setting. Japan

illustrates another form of dramatic truncation, both rebuilding its domestic economy and plunging directly into an ambitious export strategy in the twenty-five years following the war. Each of these situations had unique properties, of course, and sophisticated caution must be used in extrapolating them to new situations. However, in the complete range of approaches used, including failures as well as success stories, there are helpful guides for almost any situation. Most importantly, many of the success stories can very clearly be linked to the careful integration of key elements of other countries' management experiences into the setting in which the success was achieved.

Why are these learnings in management so important? Industrialization and efficient innovative approaches are sometimes thought of as problems of research and development or capital formation and allocation. However, most records of successful development strategies and projects shows that effective management is both the absolutely necessary and often almost solely sufficient condition for success. Enormous research, development, and project capital investments have been made in some cases with results of only waste, confusion, and discouragement because of management failure. In contrast are striking success stories in which motivation and creative management achieved tremendous results despite a lack of normal material or financial necessities. Sound management is the key to effective use of any other resources available. It is for this reason that the IIASA study of a wide variety of actual case histories of management for innovation in

many diverse social and economic settings may have relevance for industrialization strategies in developing countries.

II) Findings of the IIASA Study

An important over-arching consideration from the Study case histories is the realization that innovation itself has many different aspects and meanings in different situations. Thus the management approaches to strategy, organization, or the human aspects of stimulating productivity, creativity, and motivation must all take different forms in different settings. Though this appears to be a simple concept, the lessons of many case histories show how easy it is to become blinded to the reality that a single management approach may simply be inappropriate to the circumstances and goals of the variety of situations faced in industrial management. The most striking example of the need to differentiate forms of innovation management, discussed in several papers of the Study, was the need to distinguish process and product innovation. Process innovation is often associated with efficiency, and management techniques to achieve it are often oriented to careful organization of work and detailed planning of its accomplishment. The outputs are usually incremental improvements on production of existing products, making them faster, less expensive, or of higher quality. Product innovation usually implies using science or technology to devise a whole new product or tool, something that will need to find an entirely new market. Nurturing

imagination and individual creativity is usually the dominant management approach in this case, and the organization or detailed planning steps may be counter-productive. The two types of innovation may be so distinct, in fact, that success in one can preempt efforts in the other. That is, great accomplishments in improving the efficiency of a manufacturing process may lower prices and broaden applications so that product innovation becomes less and less important. On the other hand, an entirely new product to serve a consumer function may make meaningless even the grandest process improvements in the old technology.

Key papers[4,5] in the IIASA Study highlighted the need to approach these two aspects of innovation with very different sets of management tools. Nonetheless, it also became apparent that at some time the two kinds of innovation merged:[6] advances in process innovation could be so striking as to catapult a technology into a whole new world of applications and products (eg: processing of silicon chips to create microelectronic devices). Similarly, product innovations can completely change process approaches (eg: microdevice in control of manufacturing robotics). Management systems must above all be flexible and rapidly adaptable to be able to deal with the problems and opportunities of these complex situations.[7,8]

Some conventional wisdom would normally point to process innovation as the key concern of industrially developing countries. Both in the import substitution and later export-seeking phase of industrial development, key objectives

of increasing volume, lowering price, and increasing quality of domestic production seems to point strongly to process improvement. The IIASA study shows clearly the Bulgarian success in process innovation aimed at import substitution,[9] as well as the Japanese post-war accomplishments in quality-oriented process improvement which led to their enormous effectiveness in capturing world export markets.[10] However, caution is again warranted to guard against allowing such conventional wisdom to blind management in developing countries to the unique opportunities which arise in contradiction to the expected patterns. Concentration on process improvement cannot be allowed to preclude taking advantage of those rare but powerful opportunities presented when a local product, idea, or approach can lead to the breakthrough which opens markets all over the world to an entirely new product. It is the ability to see and rapidly take advantage of these rare opportunities which may be much more important to effective management than elaborate systems.

Going beyond the issues concerning the various kinds of innovation which must be contemplated in an industrial system, there are important lessons in the major areas of planning, organization, and "human factor" management approaches. The latter is taken to mean those aspects of management which are especially concerned with human behavior, including techniques to nurture creativity, motivation, responsibility, and the reaching in every dimension of the full capacity of the human being in his work situation. These are examined below with the goal of seeking opportunities for management in the developing countries to avoid some

of the costly and painful myths and inappropriate ideas that have often dominated management in the industrial world.

IIa) Issues in Planning for Innovation

A key finding from many case studies is that one of the most basic common concepts of planning is very largely a non-productive fiction in the innovation management area. That is, the notion of planning as a roadmap to the future, with a carefully laid out set of steps and timetables, is not often applicable in real life strategies for innovation. Instead, progress is often marked by the ability to respond quickly to unexpected opportunities, or to change directions quickly when unexpected obstacles or changes in external conditions are encountered. The paradigm of planning as an innovation roadmap can easily become a burden in a world of rapidly changing technology and world economic relationships. The planning system in this framwork can become a conservative drag on the adaptability of the system, forcing conservatism and incrementalism where opportunities for much larger steps exist.[11]

A much more effective paradigm appears to be that of the planning system as an internal communication and sensory-feedback mechanism. That is, the planning process becomes a way of allowing individuals and subunits of an organization to lay out and compare goals, perceptions of threats and opportunities, and ideas of strategies as they are understood <u>at a given point in time</u>. Ideally, in addition, it is also a system of gathering information on how those

perceptions change over time, and of bringing that information into a continually adjusting strategy-forming process.[12,13] In this model, the "correctness" of the initial perceptions or the initial strategies laid out based on them is much less important than the correspondence to reality which is gained through the sensory-feedback process. The case histories on the IIASA Study have shown that many countries have tried mechanical and supposedly universally applicable planning systems.[11,14] However, the common experiences of firms in both the market and centrally planned economies has been that hoping for effective foresight or simple formulas for success from such planning systems is largely an illusion. Instead, the vital criterion for success is the ability to honestly exchange accurate information rapidly, to candidly compare expectation with reality, and change direction as needed.

With this view of the purpose of the planning system, certain criteria for success emerged from the IIASA case histories which were quite different from what might be expected from many conventional professional planners. Keeping the planning system, plan, and planners close to the concerns of consumers of the product was foremost, with the idea again being echoed from the most to the least developed countries in the study, and spanning the experience of socialist or market economies.[8,15]

Many original approaches to achieve this coupling were discussed. All of them depended, however, on the presence of another vital characteristic of an effective planning

system in the broader sense of which we are speaking here. That characteristic is rapid, open, and honest communication. One participant pointed out that "communication is the Achilles heel of a planning system".[7] Anything that provides an incentive to slow or distort information about the needs, goals or constraints of a planning system risks putting the entire apparatus into a costly, wasteful, and self-destructive loop. This need for incentives for openness and honesty in internal communication, when viewed in the context of the planning system as an information processing and feedback system, becomes far more important than conventional concerns for accuracy in seeing the future, or the mechanics of setting goals or measuring their fulfillment.

Similarly, in the context of considering a planning system as fundamentally a communication system, the need to achieve broad and deep participation from all levels of an organization emerges as a dominant consideration.[6,16,17] The snapshot of goals, and perceptions of problems and opportunities, which is implicit in any individual's or subunits' contribution to a plan, is a vital descriptor of the fundamental character of an organization. Those descriptors merge into coherent purpose only through exchange,comparison, and discussion of those snapshots. It is that coherence of purpose, even with diversity of approaches, which often seems a vital point of any organization's success. Thus the participatory aspect of the planning system is not a frill added to a technically defined process, but a fundamental requirement for planning in order to fulfill its sensory-feedback-adaptation purpose.

Aside from the information function, the participatory planning is crucial to a concept which emerged frequently in the IIASA Study, which we have called stake-holding. That is, in order to fully commit their energy to the goals of an organization, individuals must not only be aware of plans and assumptions, but also feel a personal sense of satisfaction in meeting goals and achieving organizational success.[18] Building stake-holding is a complicated process, and of course reward systems of all kinds are normally considered as the prime tools in creating this commitment. However, modern management has perceived that building stake-holding is far from simply a question of material rewards, but has many powerful psychological elements related to sharing ideas and concerns with other members of a group, feeling recognition, and sharing with a group the exultation of success in meeting challenges. The formation and adjustment of a plan, and true participation in that process by all elements of an organization, is an ideal way to build this vital stake-holding. Numerous management devices, such as "counter-planning" initiatives from lower management levels,[19] quality circles,[20] and many others are documented as effective participatory planning mechanisms in the IIASA case histories.

A last characteristic which emerged from the case histories was the need to make adjustment of the planning an entirely natural and no-fault action. That is, it is crucial that the plans of an organization not become encumbered with personal or organizational vested interests in their "correctness" or in the distribution of power and

responsibility which they imply. Those latter characteristics are the deadly flaws that can convert a healthy and effective planning process into a heavy burden of outdated assumptions or an arena for wasteful bureaucratic struggles.[21] Management has had to learn painfully in many firms that the kind of dramatic commitment to details of a plan, which often in the short-term appears as decisive leadership and clear role definition, can lead to a painful inability to admit the need for adjustment later on. Once again, viewing the planning process in the realistic framework which is indicated by the IIASA case studies, we can see that the consciousness of a need such as this, that of avoiding the conservative tendencies of building vested interests in an unchanging approach, is not a peripheral concern but is in fact a dominant factor in determining whether the plan and planning process has a positive or negative impact on the functioning of an organization.[22]

IIb) Issues in Organization for Innovation

As in planning, management thinking has advanced beyond considering organization as a mechanical or purely technical consideration of grouping people and functions. Instead, there is increasing appreciation that organizational schemes have many broader implications in terms of communication and other human needs. The opportunity for developing countries is to build on the experience-based understanding which has emerged of the diversity of organizational approaches

available, and their utility in matching the diversity of managerial challenges in organizing for industrial innovation. The experience of the IIASA case histories presents a variety of tools and thoroughly legitimizes a variety of techniques which can be adapted to suit the natural style and local needs of developing country management.

The evolution of organizational management thinking in the industrialization process has parallels to that in other management areas. A highly "scientific" approach was once considered modern, in which tasks and functions were mechanically analyzed, broken into components and specializations, and organized in terms of "machinery" or "pipelines."[23] Hierarchial structures and organization charts, showing the flow of formal authority, dominated thinking. The formal view of organization led naturally to notions of innovation approaches that involved similarly formal manipulations of the structures. Sometimes this implied integration of organizational units, effectively equating innovation with efficiency assumed to be gained by meshing the resources of two units.

Observation over time of the true sources of innovative behavior clearly showed the simplistic nature of these assumptions. The actual flow of work, information, ideas, and authority did not always match the scientific forms of organization, and creativity and efficiency did not necessarily follow from the specialization or formal definition of tasks. Thus new forms of organizational thinking began to emerge in industrial countries even before the Second World War,

and have proliferated explosively since. As a few of many examples, matrix organization evolved to recognize the complexity of needed communication in modern enterprises seeking to be innovative. Critical path and other formal scheduling approaches emerged to deal with the rigid time line demands of development projects.[23] Strategic planning functions were singled out as needing special protection and emphasis, and were designated as separate staff functions in many organizations. In some cases financial control became a dominant theme of organizational thinking, with a variety of organizational techniques being applied to enforce that point of view. Organizing on a profit center concept, so that financial accountability and local incentive became a dominant management theme, was an obvious spin-off of this trend.

Details of the origin and development of these organizational approaches can be found in many sources in much greater detail than is appropriate here.[24] The key point from the IIASA studies is the observation that though some of these techniques may have been initially heralded as "complete" and relatively universal organizational concepts, they have, in contrast, each found a special "niche" in which they are best used. In that sense they can all be now recognized as special purpose tools, as opposed to universal principles. As we observed earlier, innovation and its management must take varying forms at different points in the innovation process, or when applied to the different kinds of innovation (eg. process vs product). Developing countries, which are likely to have a wide span of industrial

development stages within their borders along with widely varying local social conditions, are probably best served by being prepared to experiment with a variety of approaches.

Most distinct in modern observations and many case histories of the IIASA Study is the realization that the nature of organizational units can have profound effects on a variety of activities not directly envisioned as related to the organizational scheme. Many enterprises are finding, for instance, that modern task force organization has implications far beyond simply that of assembling the group of individuals most needed for a specific task. As an example, companies find that interdisciplinary task forces, with participants of varying seniority and experience, become excellent training arenas for younger staff. The junior people come into direct contact with the problem solving skills of the more senior staff. By having experience in several such task groups of different composition they become aware of the variety of styles and skills that can operate successfully. In addition to appreciating the value of diversity in approach, they also see first hand the fundamental shared values and assumptions of the firm's culture.

Task forces also commonly function in another important social/psychological sense. For a period of time, they allow staff to have an intense goal-oriented work experience, often with the stimulation and reinforcement of a close-knit supportive group. Such an experience can be a powerful motivating or revitalizing force in a mid-career stage in which many aspects of working life may have become routine or heavily administrative as opposed to accomplishment

oriented. On the other hand, having the option of returning to the more routine and structured activities in the normal organizational system after such an intense experience can fulfill vital "resting" needs for key people, to avoid exhaustion and burn-out.

Internal ventures are another new form of organizational thinking in large firms, in which small quasi-independent groups are organized to pursue projects which are too speculative or long-term in nature to compete for resources against conventional product lines or development activities.[23] As an organizational device to accommodate this special kind of goal their purpose is clear. Once again, however, they often serve other important functions. In this case the "internal venture" or speculative sub-group by whatever name becomes a safety valve against the conservative pressures of the larger organization, and as such provides special environment which can be used to nurture and stimulate the most inventive and unusual minds of the organization. Those inventive and unusual individuals who might be lost to a large conservative organization can thus find a compatible home which provides them an outlet for their particular interests.

Quality circles and similar special discussion or task groups are another new organizational form with very strong implications for social interaction.[20] The quality circle idea has many forms, but one of the most important is that in which different levels of management and workers come together to discuss actions dealing with production problems or opportunities for improvement. Clearly the quality circle

is a powerful mechanism to enhance communication about issues of vital importance to the firm, by breaking out of the pattern of formal communication through structured chains of management. At the same time, the concerted work of the group to find solutions becomes a team-building mechanism with utility spreading to situations beyond that of the immediate problems at hand.

A special issue has emerged in many of the IIASA member countries concerning the proper organizational approaches to relating research efforts to advanced product development and manufacturing.[25] Once again a pattern of experimentation has emerged, ranging from concentrating research activities in large and separate institutes, to closely coupling researchers to operating divisions of the firm, or including them in development project task forces. A variety of devices are used to bridge the gaps, including complicated contracts between the research organization, manufacturing units, and eventual customers.[26] The importance of the social function of organizational schemes is especially emphasized by case histories on the dynamics or research groups and their interactions with other parts of an organization. Internally, innovation management is coming to understand that a research group must have a delicate balance of independently creative scientific minds and members who are able to interact with the needs of a larger organization, drawing needed information in and being able to effectively communicate it outward.[27] Similarly, the organizational coupling of the research with application needs must be loose enough to give independence and an appropriate time

scale to research projects, and yet close enough to keep the research relevant to real needs of the organization, and translatable into terms that can be communicated to operational levels.[28] The organizational landscape is littered with research institutes which have become so distant from the applied field they were meant to serve that they can no longer be considered as part of a coherent product development strategy. On the other extreme, there are abundant examples of research groups that have become so enmeshed in operational pressures that they are no more than technical consultants to the day-to-day problems of manufacturing management. The conceptual steps from basic research results to advanced development, application, manufacture, and marketing, which can sometimes be naively drawn as simple lines between boxes representing various task groups, are much more complex and rich in human social interactions than is commonly imagined.

In addition to recognizing all the complex human elements of any existing organizational structure, there is a growing realization of how complex the effects of <u>changing</u> the structure can be. Management has often viewed "reorganization" as a simple function-oriented operation designed to periodically bring resources and capabilities in alignment with goals. In fact, it can become an enormously disruptive process loaded with tension of changing power and personal relationships. The extent of the disruption may be such that the relevance of the reorganization to the original goals can easily be lost. This is not to say that case histories show that reorganization to serve

functional needs is never warranted. However, as in planning, experience does show that the human and social impacts are not incidental to technical considerations, but are in fact intimately coupled with them from the start.[29]

IIc) Issues in "Human Factor" Management for Innovation

We have already stressed that the IIASA case studies pointed vividly to the strong need for consideration of individual and group psychological behavior in management of planning and organizational strategies. This leads to the broadest conclusion of the papers and case studies in the "Human Factor" aspect of the IIASA study. It is not only that human factor considerations were seen to be linked to other purposes or aspects of management strategy, but that they were the dominant underlying themes in many cases.[22] In that sense the lessons from experience were not that the human aspects must be incorporated at some point into other aspects of management thinking and activity, but that often they should be the first consideration before other so-called functional needs are considered.

This central consideration provides the most exciting aspect of the opportunities for management in developing countries. Measured against the pain and waste entailed in the history of management which failed to recognize the key human role, there is a wide margin for progress and achievement available to management in the formative stages of industrial management traditions in the developing countries. As we have seen in both the planning and

organizational aspects of the management case studies, management thinking has tended in many areas to begin its evolution with a largely mechanical, geometrical, or quantitative view of its tasks. Given the age in which the industrial revolution evolved, there is no surprise to this. Control and quantification were seen as necessary to order in a complex system. What was missed was that these were insufficient, and needed to be enriched with a great many perceptions about the nature of human behavior. The result was that management systems emerged periodically in a pattern of elegant appearing models, which were unfortunately doomed to failure given all the human characteristics that were neglected in the mechanical elegance.

Developing countries can take from this experience the chance to realize the unfulfilled potential of management oriented toward building on the human factor from the start. Rather than ignoring it, or trying to force it into mechanical paths, they have the chance to wisely combine the goals of innovation and productivity with the goals of human satisfaction and personal fulfillment. Not only does experience show the practical effectiveness of this approach, but it is a path that has great value in areas well beyond the organization of work. A work environment that stresses the development of maximal human potential, of local responsibility and authority for decisions and activities, and of team-building as a pathway for personal success, has great positive values in application in all aspects of life.[22]

Foremost among the issues emerging in the "human factors" aspect of the study was the notion of building true self-interest in the success of the organization on the part of all within it -- a process we have called building stake-holding.[22] The stake-holding process has the power to overcome many other weaknesses in a management system. With the sense of stake-holding, individual or local ingenuity can take over to compensate for many failings in the management system or for resource lacks. Without it, even the best designed and supplied system is likely to perform sub-optimally.

It is in this area that some of the most interesting experimentation is going on around the world. Developing countries have the special stake-holding drive of sharing with their people the excitement of building something new and of striving together to achieve recognition and economic self-sufficiency. Organizations have long recognized this sort of management motivational approach, but have often compromised its effectiveness by sending conflicting signals which tend to destroy the natural sense of goal-identity that might be present. The IIASA case histories are perhaps most vivid in this sense. That is, though stake-holding is a very natural feeling among members of a group, it can be lost by measures which compromise the sense of goal identity.[30,31]

In this area of maintaining the natural sense of stake-holding, several important themes emerged. One was the utility and importance of decentralization of both authority and responsibility, wherever possible.[32,33] These

themes are seen in industrial management around the world today, as management recognizes the potential for growth at all levels of the firm when a sense of local importance is conveyed. Even the so-called centrally-planned economies are experimenting with a variety of local autonomy measures;[34,35] at the same time strongly centrally managed U.S. firms are beginning to implement "quality circles" and other autonomous work team ideas to accomplish the same goals.[20] Participatory planning, mentioned earlier, is just another form of using a decentralized approach to convey a sense of stake-holding.

Reward systems are, of course, the most traditional way of building stake-holding in many societies. Especially as organizations grow large, and transcend traditional groupings in which stake-holding is a natural feeling, material stake-holding through sharing rewards of the organization with its members becomes important. Perhaps most significant of the historical lessons in this area, however, is the ease with which an organization can fall into the trap of having the reward system become counter productive to real goals. Especially dangerous are reward systems that are manipulative, or tend to stress appearance rather than substance in the nature of the rewards. Very often those in an organization are extremely adapt at detecting this kind of manipulation, and very soon it is found that appearance rather than substance is also dominating the performance which triggers the rewards. Similarly, the attempt to quantify performance in a manner which can be used to quantify rewards often also promotes distortion

of performance away from the true goals of organizational success. This has led to one important change in management thinking in recent years concerning reward structures. Partly through learning from Japanese experience, many western firms are moving to reward systems which key the rewards to group performance and success rather than individual achievement or accomplishment of individual goals.[22] They have learned that individual goals are not only difficult to equate with the over-all success of the organization, but also they may even be contradictory or counter productive at times. Moreover, modern experience shows that identity with group success can often be a much more powerful driving force than individual achievement. This lesson is just one of many which has illustrated the value of cross-national comparison of experience through studies like the IIASA case histories.

Another increasingly recognized factor in building the sense of stakeholding is the theme of bringing consumer pressures close to all parts of the organization.[8,36] In many ways this is very analogous to the point of allowing group success to dominate reward systems as opposed to individual achievement. Ultimately, the success of an organization is determined by its effectiveness in serving the consumers of its product. To bring that true measure of success to the full consciousness of an organization requires effort to avoid allowing local goals to blind components of an organization from the over-all measure of success. A variety of innovative approaches to this

challenge have also surfaced through the IIASA case histories,[37,38,29] and illustrate the variety of tools which are at the disposal of developing countries as they move into modern industrial management.

With the fundamental need for stake-holding established in an organization, most case histories show the need to ensure that the internal management climate stimulates and does not inhibit the innovative behavior desired. Simplest but perhaps most powerful of these concepts is the notion of simply removing barriers to innovative behavior. Management experience has often shown a powerful correlation between size and age of an organization and the decline of innovative behavior. Yet the case histories show that it is not simply age and size which are the inhibiting forces, but instead it is the multiplicity of barriers and checkpoints on decisions which seem to grow as companions to age and size.[13] Some of the most successful case histories show that this fatal linkage can be overcome by making the systematic dismantling of such barriers a part of the continuing process of innovation management in even a mature organization.[22] The observation rests on a key element of human factor management experience: given lack of barriers and disincentives, humans tend naturally toward innovative behavior. Often the most important element of innovation management is to remove these barriers and disincentives.

A second factor in the internal climate has been mentioned before in connection with planning, though it affects almost every aspect of an organization's capacity for innovative

behavior. It is the issue of open and honest communication. We have seen that this is absolutely essential for the important feedback-adjustment system in planning. However, for effective reward systems, for creation of goal-identity and stake-holding, for understanding consumer pressures, and in almost every other area of management, the maintenance of open communication is also essential to the performance of the system.[29] Thus, whenever new management steps are being considered, experience shows that crucial in the factors which must be weighed is the issue of whether the new step will provide incentives or disincentives for effective and honest communication. If it is the latter, the organization must face the fact that it risks losing part of its sensory apparatus and blinding itself to important realities if it goes ahead with the measure.

Closely linked to the need for open communication is the growing stress on team-building as a vital aspect of management for innovation.[27,39] Modern industrial production and product design is too complex to be within the scope of one individual's imagination and competence. Increasingly, modern management experience has shown that openly communicating teams can be much more creative and effective than individuals in certain situations. In common with the diversity seen in other aspects of innovation management, we have found that there is a proper setting for the individual role as well as that of the team. However, the team approach is certainly one which should be prominent in the set of management tools. In developing countries especially, where the numbers of trained and experienced

people may be initially small, the team building aspect of an organization's internal climate may be essential.

Last among the internal climate aspects of innovation management are the incentives or disincentives for risk-taking.[40,41] Many factors in the case histories point to this as a key issue, and one which must be dealt with explicitly by management. With size and maturity, and sometimes with support from distorted reward systems or poor communication, the disincentives for risk-taking can grow rapidly. Yet the case histories show acceptance of risk as an essential element of innovative behavior. One of the important weaknesses of many mature management systems is the notion that "failure" is to be equated with "errors" or "poor performance". In contrast, innovative behavior is based on the understanding that a certain amount of failure is a natural consequence of taking risks. The only real question in an innovative climate is whether the rate of success over time outweighs the losses from an appropriate failure rate. Experimentation must be a part of a healthy management climate for innovation, and experimentation by definition implies acceptance of risk at an appropriate level. Building a management structure which naturally links "failure" with "healthy risk-taking", instead of with "error or mistake", is one of the special opportunities developing countries have in capitalizing on the human potential in management systems.

It is an interesting common experience in training programs for innovative behavior in mature industrial

countries that much of the need is not to teach new things. Instead, it is to un-learn some of the perceived barriers to innovative behavior that have been conveyed by poorly designed management systems. The training systems often find that the real challenge is to uncover the natural sense of individual responsibility and creativity that has too often been discouraged. This, of course, is the fundamental reason for the sense of optimism and opportunity in building management traditions in the developing countries. There is certainly need for management training of many kinds, but the burden of un-training can perhaps be avoided by jumping over the mistakes of mechanical management seen in the case histories of the IIASA study as well as in much other experience in the industrialized world.

III) Conclusions

Many specific references to the IIASA Innovation study have been cited. In some cases the lore of management knowledge accumulated in the industrial world over the last century seems overwhelming, and the task of transferring it to countries striving to achieve rapid industrialization seems formidable. Indeed there are likely to be many difficult challenges in moving from family-oriented agricultural or commercial enterprise, or from internationally managed firms, to domestically organized industry. However, the opportunity is also enormous. There is no need to begin with a fundamentally flawed paradigm, that of people as

analogous to components of machinery, in which work is to be planned, organized, and managed in mechanical terms. Instead, the developing countries have the chance to set traditions with much greater potential than those established in the industrial world in the early twentieth century. The new paradigm is that of humans as the key sensory and idea-generating components in a communication system and group endeavour. It is one in which they derive stimulation, training for new and expanded skills, and a sense of pride and personal satisfaction. It has not only been shown to be more effective in meeting goals of productivity and innovation, but will be much more natural and satisfying to implement. Beginning with this new paradigm brings the promise of an industrial management strategy which emphasizes the dignity and worth of each individual in society. It has benefits of bringing training opportunities, communication skills, team building, and individual and group initiative which will impact not only industrial innovation but every aspect of the society.

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