What is precisely R&D management and how can it be catered towards attaining innovative success within the emerging field of nanotechnology?

Kasthoory Rajalingam

*University of Malaya, Malaysia*

kasthooryrajalingam@gmail.com

**Abstract**

The myriad of interpretations associated to the term R&D management are found to be distinctively unique from one another and thereby disallowing neither common nor mutual grounds to be established among them. Based on many studies and emphases placed on R&D management, there has neither been a universally accepted definition. Even the Organization for Economic Co-operation and Development (OECD) has only defined the term R&D and not the term R&D management. Nevertheless, authors of R&D management papers have liberally illuminated the term R&D management according to their own varied outlooks and dispositions that relatively suits their own themes in question. The amount of unconventionality involved in interpreting the term R&D management is not at all being rebelled in this paper since there are many scientific and nonscientific concepts being defined variously yet preserving common ground. Nonconformity can be regarded as positive and affirmative in definite circumstances guaranteed it uproots the compound angles of R&D management seen from various authors’ point of views. However, these past and present interpretations on R&D management are radically poles apart with absolutely zero commonality or connections. This raises a question as to: What is precisely R&D management? Several interpretations on R&D management (not definitions) underscore the term innovation, knowledge and total quality management and several interpretations emphasize on technology management minus innovation and total quality management. Some authors have refrained themselves from defining the term R&D management in their papers, which cogently allows more flexibility and elasticity in the knowledge flow and also allows the reader to construct a personal interpretation of what R&D management is all about. This paper will examine what is precisely R&D management and how it can be catered towards attaining innovative success within the emerging field of nanotechnology.

Keywords: R&D Management, innovation, nanotechnology, emerging technology
1. Introduction

The presence of the thrusting force conveyed thru the term R&D management into research discussions is immensely felt during the past decade and portrays sufficient signs of the germaneness of its role towards innovation and technology. The term R&D, which stands for research and development has been recurrently used in theoretical and practical research based papers and can be regarded as a household term within the research community. There has rarely been even a single research paper, which omits the term R&D in their delivery of knowledge content. However, the term R&D management is a whole term altogether which commonsensically means management of research and development; and does not necessarily need to be expounded in all research papers unless the theme specifically focuses on it. What is palpable from the term R&D is that, it involves a series of methodical processes and tasks within scientific endeavors, which ultimately differs from one scientific field to another. Processes and tasks are never the same. This means that the route taken towards the management of R&D processes and tasks also deviates from one scientific project to another. Each scientific project will require assorted paths and directions depending on the weight, urgency, number of anomalies, stringency, level of bottlenecks obstruction, time required to resolve these incongruities, number of skilled human capital, level of communication and leadership between upper and lower management and the countries’ current economic and political environment. Nevertheless, at the end of the day, all scientific projects emphasize on a similar objective, which is to produce successful and innovative output for market consumption and to make astounding profits to ensure future and continuous incremental improvements to their existing products (if necessary) and preserve their promising and undying customer loyalty. Thus, this could be a possible reason, why a myriad of R&D management interpretations have not succumbed to a single standard of understanding and comprehension and have magnetized a series of liberalized interpretations according to their own academic and experiential stances.

Some researchers and authors have safely yet purposefully ignored the traditional act of defining the term R&D management in their lengthy pieces of research; and have allowed the definition to flow and surface naturally according to the mindset and creativity of their readers. This is not wide of the mark. However, as time transcends into deeper thresholds, there is a possibility that the term R&D management will lose focus and grounds for further continuance in research debates; and terms like innovation management, technology management, knowledge management and total quality management will take an upper hand in replacing the term which can lead to even more confusion and turmoil between theory and practice. Why this is true is because during a time where university – industry (U-I) partnerships is being effortlessly being strengthened to boost the commonly unfriendly ties between industry and academia, terms like knowledge management, innovation management, technology management and total quality management are unlikely terms to be welcomed and understood in industrial discussions since it resonates serious academic austerity and the lack of austerity in terms of product and process output. What is commonly understood and apprehended is the term R&D management, which mollifies and effortlessly enables communication between university and industry. What is the point in generating research papers about innovation management, technology management, knowledge management and total quality management if individuals outside academia are unable to digest and appreciate its content delivery? Unless this mere persistence is to create a noticeable divide between both parties or to strengthen the potentiality of highly qualified academics to become indispensable to the position of resolving the problems faced by industry one day. The
former will be disastrous but the latter will be utterly looked forward to by academia, especially myself. Nevertheless, until the role of academic entrepreneurship succeeds and allows academia to stand independently without the need of a “shoulder of a firm” to rest on in partnership to commercialize and market R&D outputs, researchers should begin to recognize the need to support the establishment of common grounds between future definitions in R&D management.

Furthermore, the proliferation of extreme academic asceticism embedded within the interpretations of R&D management may induce the creation of future academic thinkers who can visualize beyond the ordinary platforms of normal dynamos but may paralyze the current needs for solving current industrial problems, that which will only require less extreme academic austerity and more practical oriented methodical approaches. The reason is because the practical oriented methodical approaches need to be executed by normal dynamos that are available in abundance who are familiar with less extreme academic austerity compared to the few academic thinkers who have grown familiar with far-reaching academic austerity their whole advanced academic life. Another problem that arises is that when conferences organize themes specifically on R&D management, it is observed that papers accepted are from areas of knowledge management, innovation management, technology management and total quality management as well.

This surfaces a quiet realization that the term R&D management is gradually losing its identity and distinctiveness to other newly derived terms, which can ultimately create a blistering path of noisy confusion as to what is management of research and development. This does not mean that definitions on R&D management should not extend branches of multidimensional exteriors but underscores the need to confine the multidimensional exteriors within the interiors of the term R&D management, which is understood by a vast majority. This resonates the calling for the future sustainment of the term R&D management without surrendering to totally new terms known to only a handful of people, which ultimately means the same. In foresight, once the term R&D management loses its foothold in research debates and is landmovered by other newly derived terms, resurrection will be costly and it will be too late for any form of revival since these newly derived terms would have already invaded many academic research papers and university textbooks. It is already challenging and taxing for university students to apply existing theoretical terms in their everyday lives, so what more can be said if they are flabbergasted with even newer terms, which can blur their present understanding and comprehension of the term R&D management. Manifesting “definitionistic purity” in the term R&D management is not being promulgated in this paper. Nevertheless, what is being put forward in this paper is to manifest a “definitionistic litheness” in the term R&D management that can be acknowledged by all diversified disciplines and multifarious projects to achieve common grounds in terms of communication and underlying execution. The following section will elucidate the definition incongruences that have surfaced.

2. Definition Incongruences

Marieno, N. (2003) paper entitled “From R&D management to knowledge management: An overview of studies of innovation management” which attempted to study the innovatory phenomena at the micro and macro level, incongruously did not indicate or mention the term R&D management in the entire text of the paper, even though it has been made absolutely palpable in the main title of the paper. The author has identified keywords such as technological
innovation, technology management, R&D and knowledge management but oddly did not identify R&D management as an underlying keyword. Nevertheless, the author has studied several different units of micro analysis within the entities of the firm (technology strategy and organizing innovation), R&D department (organization), R&D project (managing projects) and products (new product development) but did not specifically state whether these micro features fall under the category of knowledge management or R&D management. From what is being understood and grasped from the paper content is that, it is the “knowledge of R&D management” which flows from the initiation of a strategy right up to new product development. So, why does the author purposefully and distinctively separate the terms knowledge management and R&D management, when knowledge management is an exterior within the interiors of R&D management? This is itself an evidence to state how the term R&D management has become ambiguously disarrayed in the midst of other newly derived terms due to the lack of a proper standardized commonality and pure academic research asceticism.

Nobelius, D. (2004) had identified five (5) earlier R&D management generations ranging from 1950s to the 1990s and has exemplified the Bluetooth case study as moving towards the sixth generation of R&D management. The author professes that many companies constitute a mixture of approaches depending on various factors and consequences, which does not rigidly follow a single generation religiously, as R&D management is a formidable and arduous task. This is probably why the author did not explicitly define what R&D management is, due to the consequentially diversified based versions of approaches being exploited by companies whose ultimate objective is to solve an R&D dilemma effectively and effortlessly rather than focusing on what would be the most epitomized, appropriate and acceptable standard used by all parties. This also surfaces a pertinent possibility that the reason why R&D management has not been explicitly defined could be due to the verity that there is “no one shoe fits all” phenomena that occur within the realms of R&D management. Another point that surfaces is that why R&D management is not been defined explicitly is due to the verity that R&D management is commonly a problem solving oriented mechanism practiced mainly by high projecting multinational R&D companies, who employ highly qualified R&D specialists from academia to creatively solve up to the minute and real life bottlenecks; and who rarely practices the need to succumb steadfastly to any conventional theories of meta-analytical wisdom. Nonetheless, it is an utmost disbelief why companies still continuously fail in producing innovative and successful products and have no alternative but to continuously rely on customer-generated feedback to engender better incremental based products. An R&D management approach that worked successfully for one company product today will not necessarily work for another product tomorrow, no matter how creative the strategy is made to task. Nevertheless, it is important to ensure that the correct underpinning and fundamental grounds are laid to rest in terms of defining what R&D management is without inflicting extreme academic austerity. This remains an academic responsibility in breeding future creative and marketable R&D specialists and researchers who can be capable of converting theoretical knowledge into creative and self-generative knowledge for the purpose of problem solving industrial failures.

Prajogo and Sohal (2006) have liberally, without any reference to any closely relatable conventional authority have placed technology management and R&D management as one and have compared them to total quality management. As a layman, one would think that quality to be a coherent embodiment within the nature of R&D management but to connote the term total quality management as completely a separate entity resonates a severe calling for reasoning. The authors have underscored the difference between quality performance, total quality management
(TQM) and total innovation management (TIM), which according to the authors; do not fall within the interiors of R&D management but as absolute exteriors. The authors’ suggest that TQM and TIM be implemented in combination and not as an integrated form because TQM is still confined only within certain areas and functions, which emphasize quality. Nevertheless, one is unable to battle the statements and theories contested by the authors because the authors have not explicitly defined the term technology/R&D management to enable a fair and distinctive comparison between the two terms according to their own stances. The only element that can and should be debated from the paper is why should TQM and TIM not become interior accessories that belong to R&D management even when it has been evidenced that there is a strong correlation between TQM and technology/R&D management? Based on the authors’ finding, it can be interpreted to mean that with the absence of the term TQM, R&D management alone should be defined as scientific and experimental actions, processes and tasks, which solemnly emphasize a lower level of quality and not of a higher level of quality as compared to that of TQM. Yet, Prajogo and Sohal (2006) have safely abstained themselves from explicitly defining the term R&D management in their paper, which provides all the more reason to debate incessantly as to what is precisely R&D management.

Thus, it is greatly reassuring that Jayawarna and Holt (2009) have compared both studies by Miller (1995) and Francis (1992) to predominantly arrive at a juncture to state that the distance between quality management and R&D management is narrowing as a result of overlapping and intersecting interests. The analysis made by Jayawarna and Holt (2009) on both studies unveils the possibility for this mutual intersection to shape and fortify a newer and more substantial definition for the term R&D management. Miller (1995), Francis (1992) and Jayawarna and Holt (2009) may not have prescribed an explicit definition for R&D management but have somewhat indirectly contributed towards the regurgitation of promising prospects towards the shrinking the gap between quality management and R&D management. Yet, there are many research papers that choose to disregard this narrowing trend and continue to liberally introduce newer concepts and terms that could injure the existence of the term R&D management and negatively contribute towards the extinction of this term. What is more distressing is that, at the rate it is currently moving, there are no standards of terminology adhered by organizations such as the Organization for Economic Co-operation and Development (OECD) to regulate the usage, to establish common grounds between the myriad of interpretations available for R&D management. The Organization for Economic Co-operation and Development (OECD) will need to acknowledge the need to shrink the distance between terms like quality management, innovation management, technology management, in order to mutually intersect with a more substantial and more universally acceptable term such as R&D management.

Li and Kozhikode (2009) have discussed in their paper, which is supposedly to be the implication for global R&D management without enunciating the term R&D management in their entire text. Only after comprehending the entire text, one can conjecture that the authors have focused on the present innovation landscape, which incorporates diverse challenges to multinational enterprises (MNE) and emerging economy firms. In another words, Li and Kozhikode (2009) have discussed the possible implication to global MNEs R&D activities instead of R&D management. Though the authors have made a suggestion for the need to develop own innovative capabilities and transcend from a process to a product focus, they had not made any direct ties to that of global R&D management. What can be construed is that the authors could have had another form of understanding towards R&D management, which moves far away from the interpretations provided by the previous authors on R&D management but was never defined. Observantly, Li
and Kozhikode (2009) did not relate R&D management to that of quality management, knowledge management or innovation management either. Nevertheless, one interesting question that can be divulged is whether or not R&D management should be regarded as an internal or an external system. R&D is a term that generally describes the processes, tasks and activities, which take place from within the scientific laboratories where experimentation and testing is heavily performed and is specifically known as applied R&D. What comes prior to applied R&D is basic research and not any form of R&D. There is no such thing as basic R&D. Influential factors on R&D management come in the form of both external (outside the R&D organization) and internal (within R&D organization). However, R&D management is definitely to be regarded as an internal management system, which requires the designing, leading, smooth transfer of know-how from the inside to the outside and not the other way around. Therefore, R&D management requires the skills and expertise of both the R&D manager and R&D scientist. Another question arises as to whether R&D expenditure (R&D spending) falls under the system of R&D management.

Mudambi and Swift (2011) posit that R&D expenditure volatility indicates the presence of proactive R&D management. Therefore, yes, R&D expenditure does fall under the system of R&D management but the same cannot be said for R&D investment. R&D investment is a constituent that is lubricated from outside the R&D department, which could be either governmental or non-governmental agencies or departments hailing from outside the company, within the same company or from another subsidiary. Both the R&D manager and R&D scientist are never involved in R&D investment but are involved in the planning of relevantly spending the allocation invested on their projects efficiently and effectively by scheduling an outlay of expenses, costs, payments, outgoings and disbursements. Thus, it can be put forward in this paper that previous studies on R&D management have not pointed out definitively and conclusively what R&D management precisely means and is almost losing its footing in research debates to other extraneous terms and interpretations’. Interpretative differentiation is highly admired in research debates but not to the extent of altering its core and underpinning meaning. Researchers, due to the lack of common grounds are liberally displacing the term R&D management.

3. R&D Management for Nanotechnology

The previous section clearly elucidates that the term R&D management has neither secured nor been officially bestowed with a permanent identity of its own and continues to create a discreet but mind-perplexing tussle among the multi-interpretative authors of R&D management due to the absence of a conjoint agreement that could assist in preserving its core and fundamental meaning. The reason why it is being described as a discreet and mind-perplexing tussle in this paper is because authors of R&D management seem to advantageously opportune the absence of a definitive term for R&D management; and thereby leaving the readers who are non-authors to passage through a puzzling labyrinth. It is obvious that these authors are extreme visualistic explorers’ but not ritualistic and are uninterested whether or not their readers will be able to comprehend their visualistic exploration. In other words, these authors are in the world of their own. R&D management is pertinently required today in every field of scientific endeavors especially in the emerging field of nanotechnology. Nanotechnology, nevertheless, in contrary to the term R&D management has secured a permanent definition and is commonly defined simplistically as the scientific activity, which takes place between 1 – 100 nanometers (nm) that diminishes beyond the size of the mere microscopic phenomena, and its definition has been
extended to suit advanced scientific thinking by multifarious fields who deal vastly with the movement and structures of complexed nano based material, components, atoms and molecules. Furthermore, its groundbreaking benefits hailing from ostensibly uncompromising innovations generated by an indispensable R&D taskforce to gradually replace existing non nano based products are slowly infiltrating a new meaning towards the quality improvements of human civilization. R&D management is paramount to the emerging field of nanotechnology especially when this technology has received negative criticism from pundits all over regarding its future disastrous impacts.

Hence, the role of R&D in determining that nano-based products are at harms bay through rigorous testing and reengineering; and that consumers can securely utilize it, is generally given the highest priority in the development and production life cycle. As nanotechnology is still regarded as emerging, this technology stands at a greater advantage compared to other technologies in terms of R&D management. The reason is that the processes and tasks involved in high budgeted applied nanotechnology R&D based projects are “decisively permitted with grounds” by R&D managers and made to be understood by R&D scientists to investors and venture capitalist of the need to travel in reverse to the extent of basic research for the detection of fundamental underlying problems. This is even more reason why time factor plays a germane role in R&D management and is harshly constrained by conditions placed by external factors and influences such as investors and venture capitalists. The existence of such scenarios portrays the existence of immature developments in nanotechnology R&D management and also the incompleteness within the realms of basic research for nanotechnology. Nevertheless, this scenario, in a way also gives time and an upper hand to manage applied R&D specific processes and tasks through a multiple series of trial and error methodologies, which can ultimately become refined and well-practiced in years to come. It is a myth and misconception that R&D management is the same for all technologies and disciplines. The reality is that the problem solving mechanisms and bottlenecks that surface within R&D management tasks and processes are always different and unique, and require a different set of lenses each time. The question arises as to how can a definition placed for R&D management help execute the processes within R&D management especially for nanotechnology? First and foremost, a definition, no matter how traditional it may sound, fortifies common guidelines to adhere to, without going astray. No entity reinforces a rule or law to stringently and religiously follow a standard definition but generally reinforces a rule, so that not to alter its core meaning. Nevertheless, extensions should be allowed to permit visionary resourcefulness and field suiting interpretations. When a standard definition is placed, then that itself automatically sets the stage for the identification of acceptable and unacceptable parameters within R&D management. For example, when R&D expenditure is identified as an element set within R&D management, no one should come forward to state that R&D investment also falls within the realms of R&D management. If this happens, this utterly alters the core meaning of R&D management and its new interpretation goes off track.

The core meaning distinctively emphasizes “management of R&D” which means “management of resources to conduct the processes and tasks of R&D”. However, if an interpretative extension is required, then one could say that R&D management is a process that can only be successfully executed with the requirement of an outer boundary entity known as R&D investment. Simultaneously, a well-placed definition directly assists the human capital, who is trained theoretically on the definition of R&D management, at the beginning of their engineering education to relate these principles in their practical executions. Many R&D specialists today are unconsciously applying theories that were consciously absorbed during their engineering
education but remain to be resolute without confessing these truths because a severe trend has been infested into the minds of the work oriented individuals that practical triumphs over theory, which is not necessarily true. Theory is the foundation of any practical endeavor. The only element that extraneously surfaces from passionate practical endeavors is a more creative mind. That is why the core meaning of R&D management should be fortified to suit the needs of both practical and theory, since execution is successful only when both are dealt with in perfect combination and not as solitary entities. In terms of nanotechnology, R&D management has to be viewed through a diverse set of disciplines ranging from the arrays of Biology, Chemistry, Physics, Engineering and its respective sub-disciplines. In reality, nanotechnology does not belong to any specific field of science. Therefore, this means that human capital for nanotechnology will need to engage in the multifarious patois and understandings of various disciplines put together in order to be able to contribute greatly in nanotechnology innovations and technopreneurship, which can generate a great number of skilled R&D managers for nanotechnology. Furthermore, if the parameters of R&D management are definitely defined, then the tasks and processes can be equally be defined as well, and areas that require the most focus in terms of quality and in depth knowledge, can be made a priority for further concentration in universities offering the subject of nanotechnology science, management and entrepreneurship.

4. Conclusion

This paper has made every effort to bring out the germaneness of defining the term R&D management to suit both practical and theory. As explained in the earlier sections of this paper, the definition is not in any way restricting any form of creative interpretations generated by authors but encourages the need to adhere common grounds, so that any form of interpretations in the future will be comprehensible and practically applicable. The introduction of newly derived terms currently stands in obstruction towards this possible reality. Instead of creating newly derived terms, researchers should find a way to reduce the gap and distance that currently disallows the unison of these terms to merge with R&D management. Assuming that every path taken is based on consequences, which leads to timely and untimely creative resolutions, there are times when traditional ways of explicitly defining a term can go a long way in solving a myriad of advanced problems in both academia and industry.

References